



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

November 6, 2013

### **Group Chairman's Factual Report**

# **METEOROLOGY**

**ERA13FA358**

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## **A. ACCIDENT**

Location: 3 miles southeast of New Haven, Connecticut  
Date: August 9, 2013  
Time: approximately 1121 eastern daylight time (1521 UTC<sup>1</sup>)  
Aircraft: Rockwell International 690B, registration: N13622

## **B. METEOROLOGY GROUP**

Paul Suffern  
Senior Meteorologist  
National Transportation Safety Board  
Operational Factors Division, AS-30  
Washington, D.C. 20594-2000

## **C. SUMMARY**

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

## **D. DETAILS OF THE INVESTIGATION**

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Climatic Data Center (NCDC). All times are eastern daylight time (EDT) on August 9, 2013, and are based upon the 24-hour clock, where local time is -4 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident location was located at latitude 41.28° N, longitude 72.89° W, elevation: 55 feet.

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<sup>1</sup> UTC – is an abbreviation for Coordinated Universal Time.

## **E. FACTUAL INFORMATION**

### **1.0 Synoptic Situation**

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP), and the Weather Prediction Center (WPC) located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the, joint NWS and Federal Aviation Administration (FAA) Advisory Circular “Aviation Weather Services”, AC-0045G CHG 1.

#### **1.1 Surface Analysis Chart**

The NWS Surface Analysis Chart for 1100 EDT is provided as figure 1, with the approximate location of the accident site marked. The chart depicted a stationary front in northern New York stretched northeastward into southeastern Canada and a cold front in western New York stretched southwestward into the Ohio Valley. A surface low pressure system was located in western New York with a surface pressure of 1009-hectopascals (hPa). The station models around the accident site depicted air temperatures in the low to mid 70’s Fahrenheit (F), with temperature-dew point spreads of 2° F or less, a south wind between 15 and 20 knots, cloudy skies, light rain, and mist.

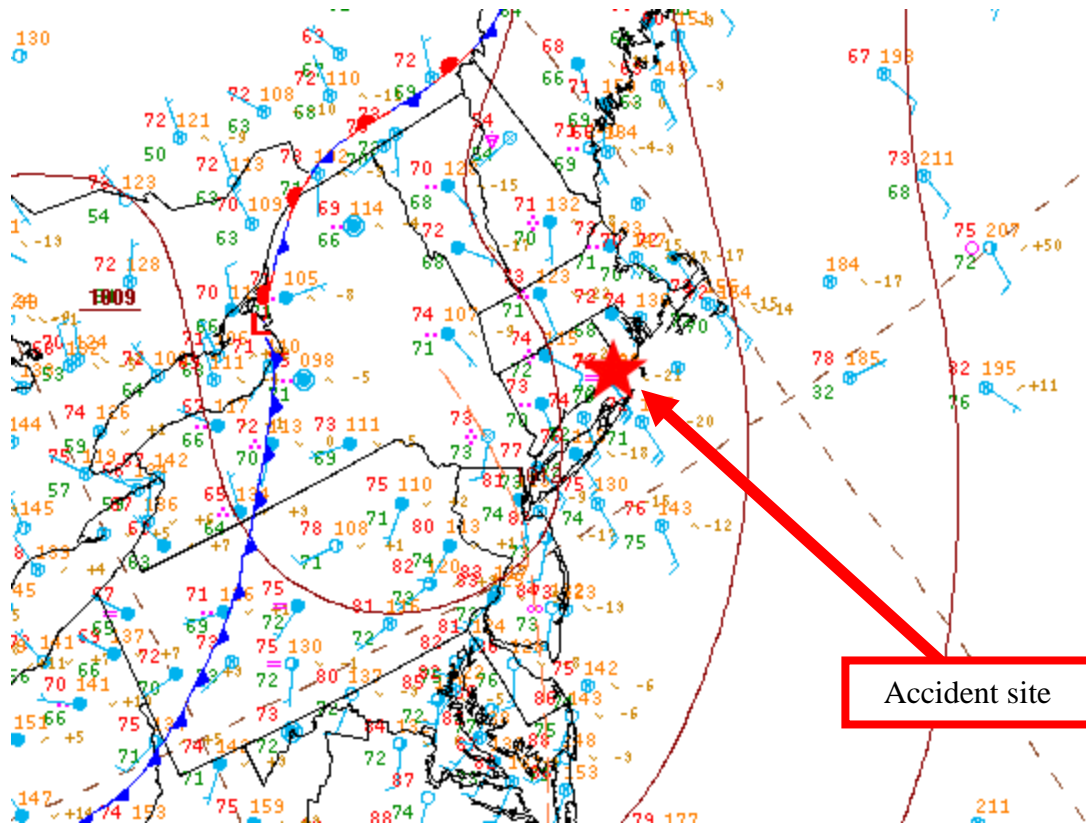


Figure 1 – NWS Surface Analysis Chart for 1100 EDT

## 1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, 700-, 500-, and 250-hPa are presented in figures 2 through 6. The 925- and 850-hPa charts depicted a low-level trough<sup>2</sup> west of the accident site with a 20 to 30 knot south to southwest wind (figures 2 and 3). The wind increased to 50 knots by 250-hPa (figure 6), with the wind at 250-hPa out of the west.

<sup>2</sup> Trough - An elongated area of relatively low atmospheric pressure or heights.

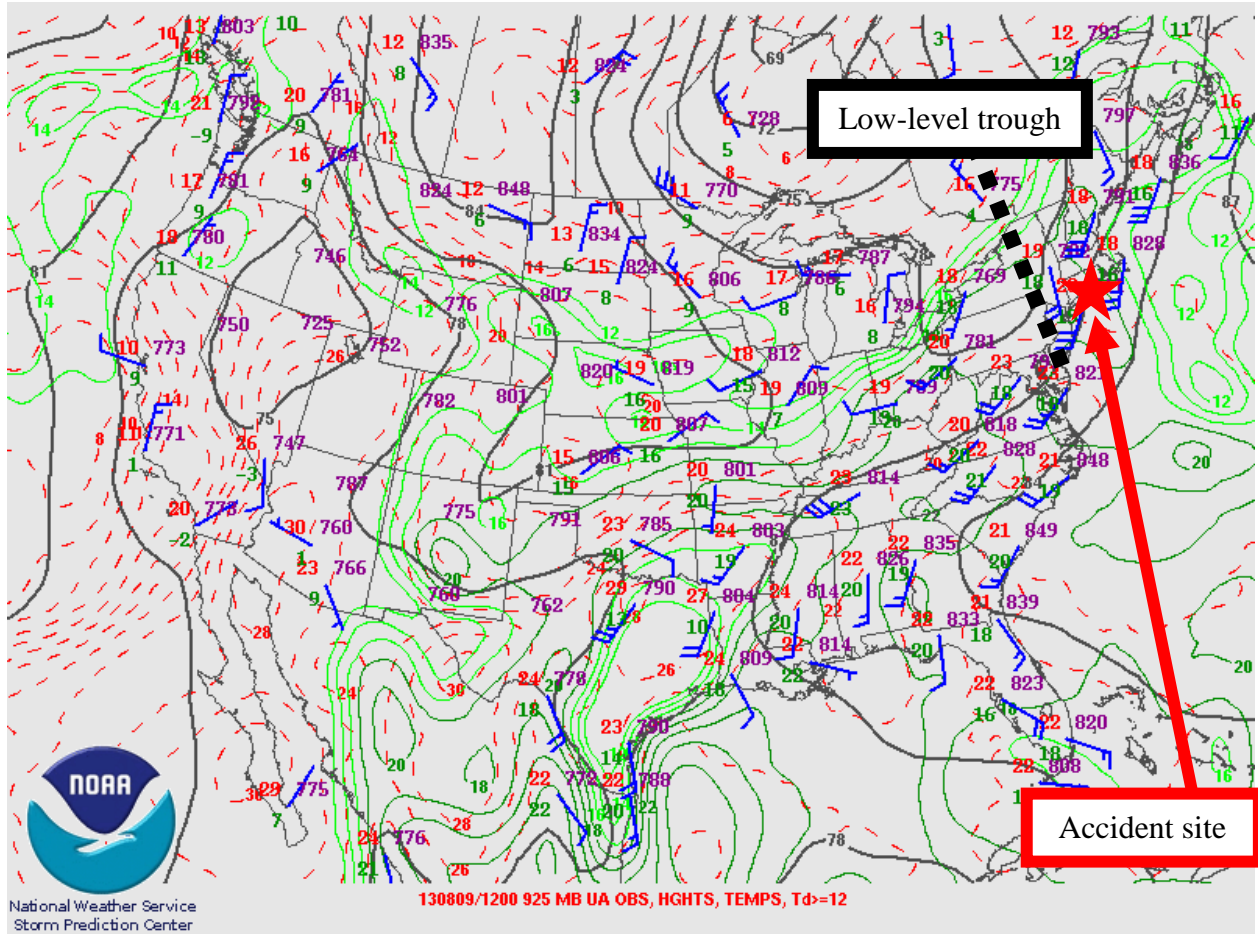


Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

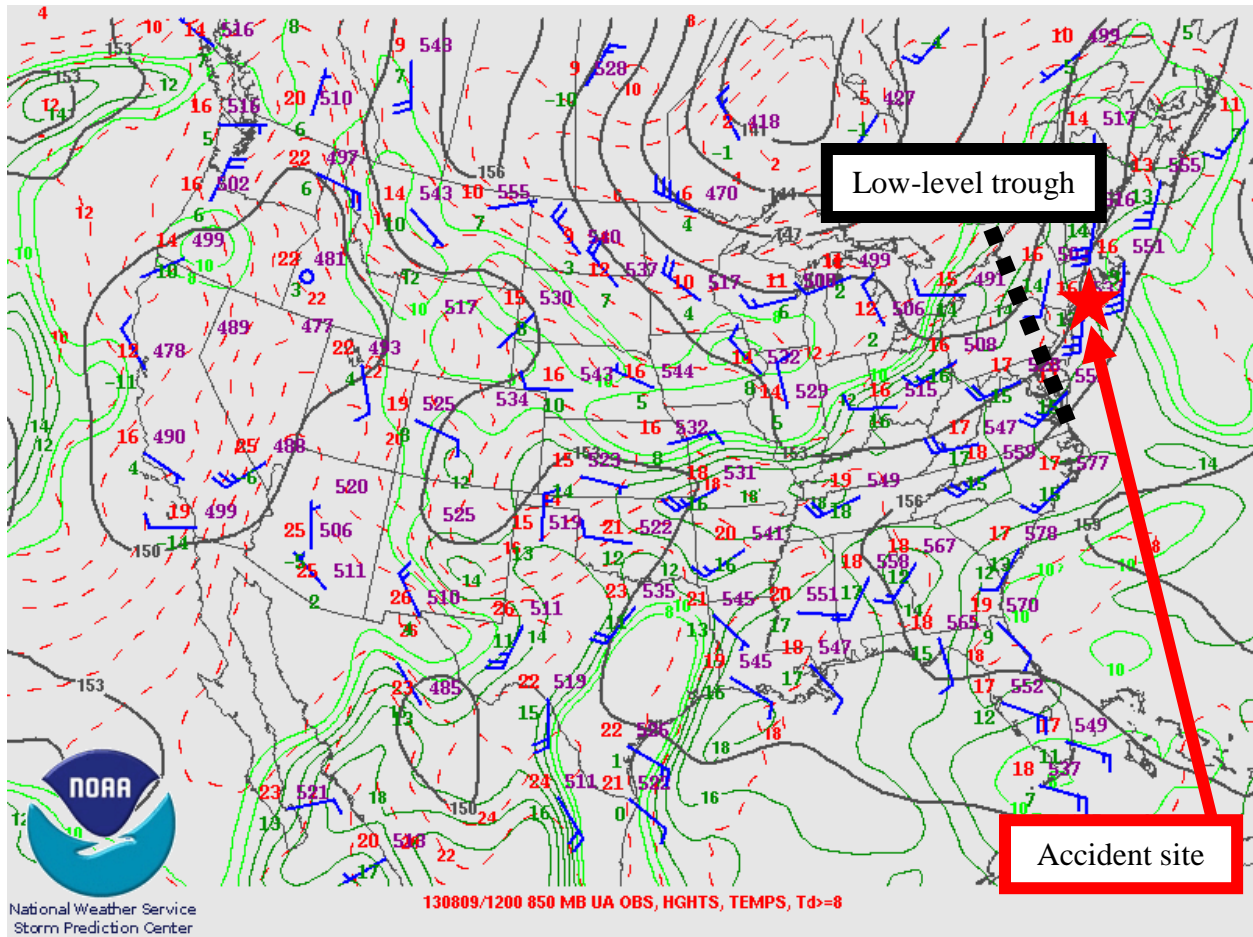
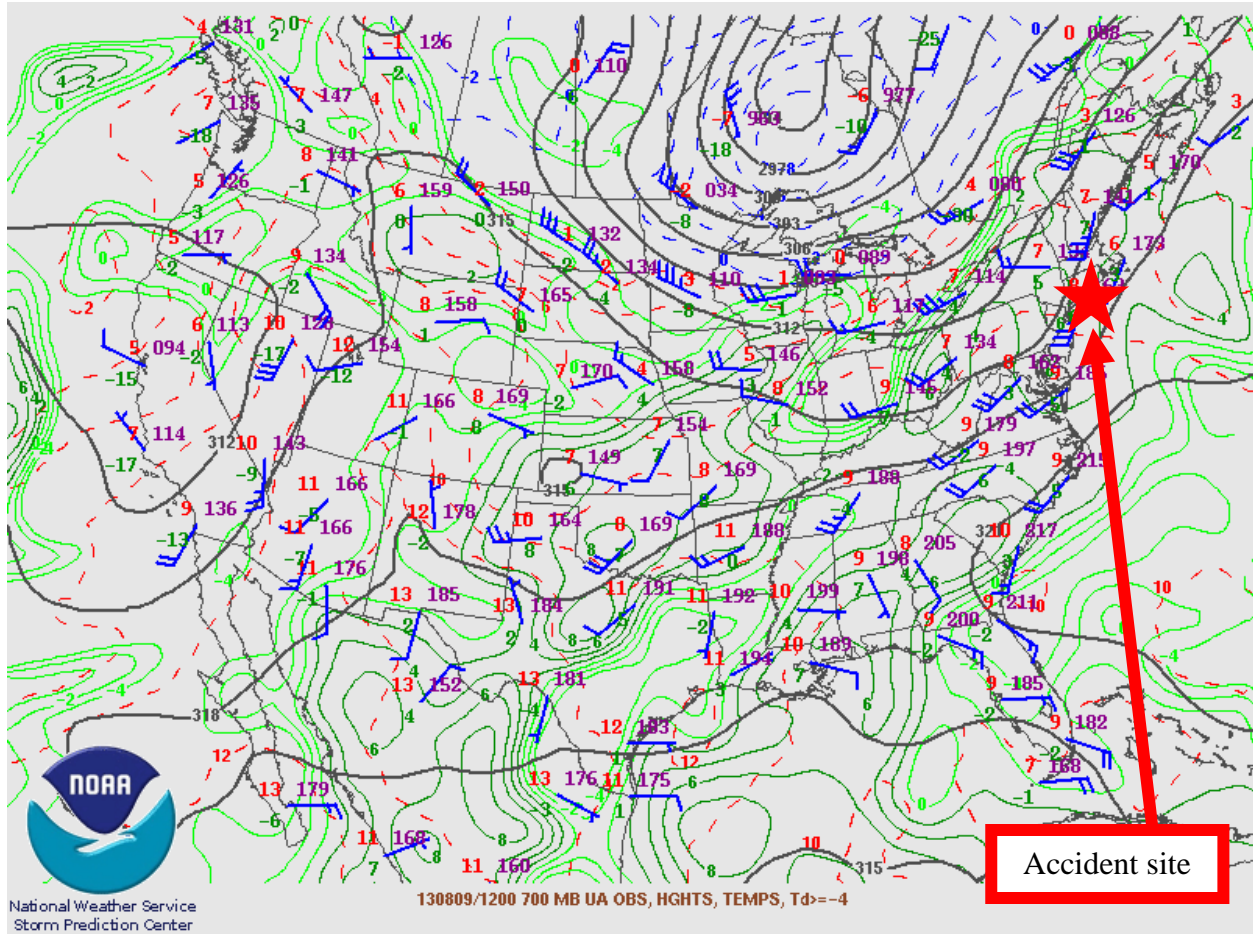


Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT



**Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT**



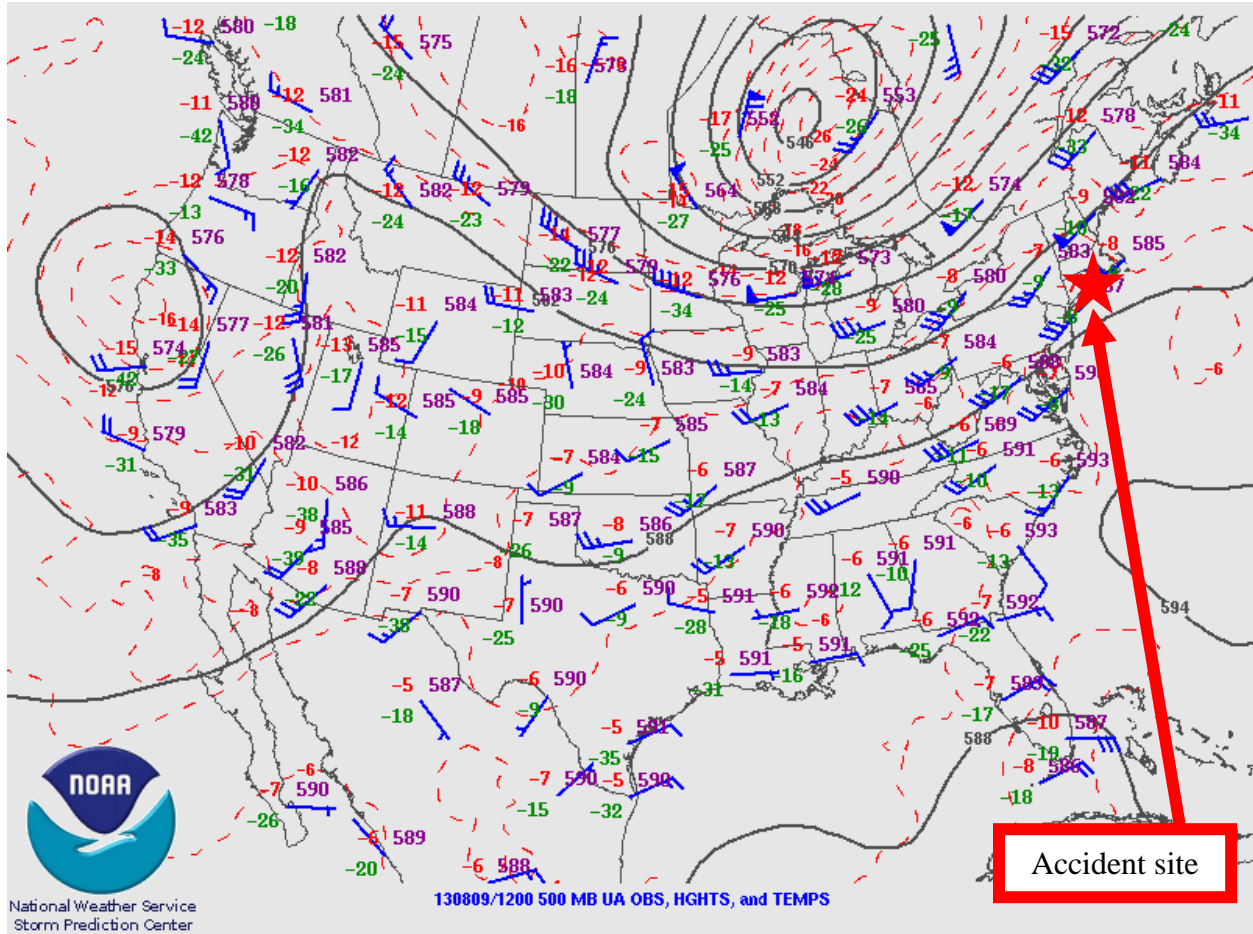
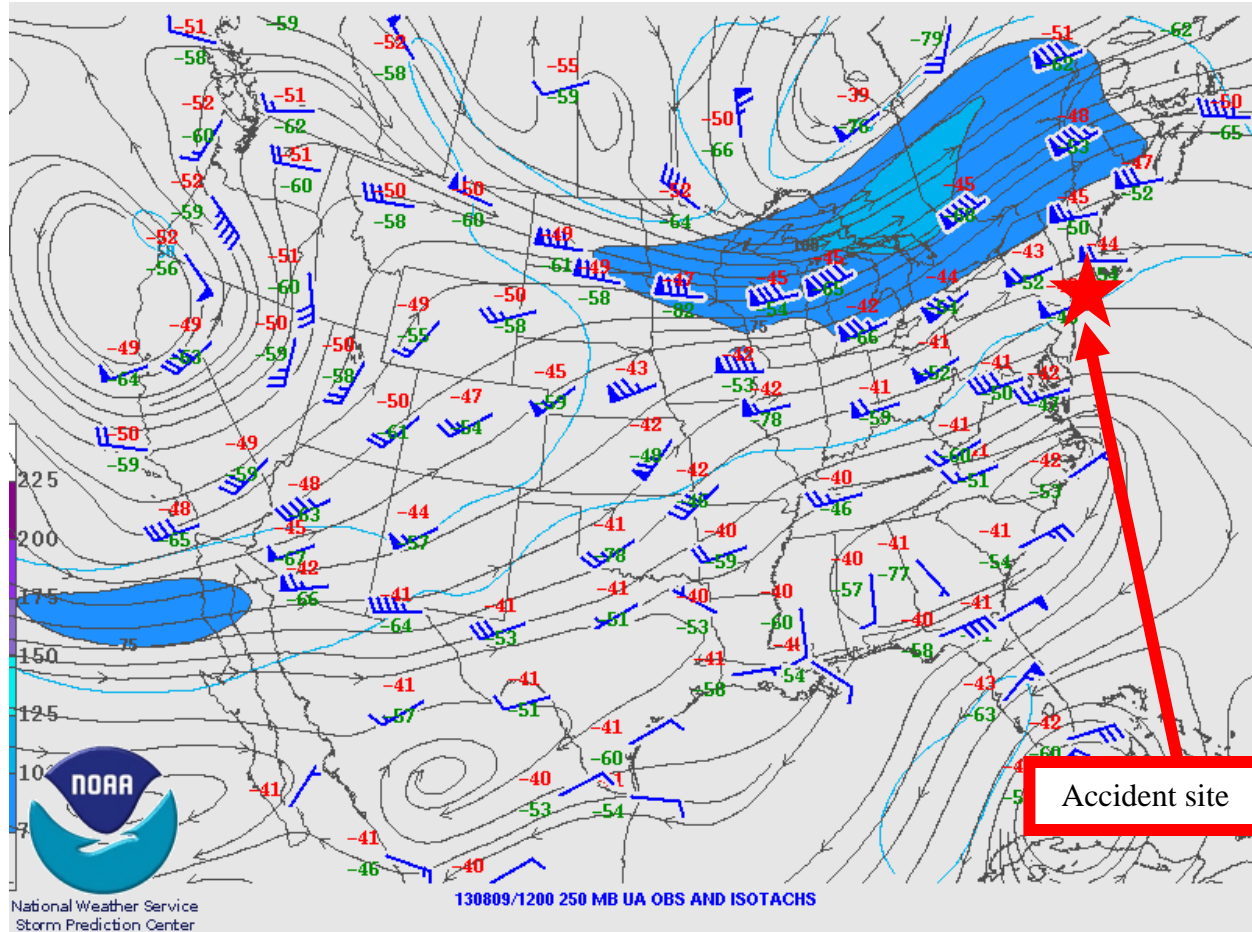


Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT



**Figure 6 – 250-hPa Constant Pressure Chart for 0800 EDT**

## 2.0 Storm Prediction Center Products

SPC issued the following day 1 Convective Outlook at 0831 EDT (figures 7 through 9) with areas of thunderstorms forecasted for the accident site with a chance of some severe thunderstorms. The accident site was located in an area where SPC forecasted a 5 percent chance of damaging thunderstorm winds or wind gusts 50 knots or greater within 25 miles of a point<sup>3</sup>, and a 2 percent chance of a tornado within 25 miles of a point<sup>4</sup>:

SPC AC 091231

DAY 1 CONVECTIVE OUTLOOK  
NWS STORM PREDICTION CENTER NORMAN OK  
0731 AM CDT FRI AUG 09 2013

VALID 091300Z - 101200Z

<sup>3</sup> For more information on severe weather within 25 miles of a point see:

<http://www.spc.noaa.gov/products/outlook/probinfo.html>

<sup>4</sup> The bold sections in this NWS product and the rest of products in the weather study report are to highlight the individual sections that directly reference the weather conditions that are or will affect the accident location around the accident time.

...NO SVR TSTM AREAS FORECAST...

...SYNOPSIS...

A CLOSED LOW OVER ONTARIO IS BEGINNING TO ACCELERATE TOWARD QUEBEC...IN RESPONSE TO UPSTREAM HEIGHT FALLS FROM THE WRN SHORE OF HUDSON BAY INTO NRN MANITOBA. A MID-UPPER SPEED MAX WILL LIKEWISE TRAVERSE THE GREAT LAKES AND NRN NEW ENGLAND ALONG THE SRN PERIPHERY OF THE CLOSED LOW. AN ASSOCIATED SURFACE COLD FRONT WILL PROGRESS SEWD ACROSS PA/NY AND THE OH VALLEY TODAY...REACHING SE NEW ENGLAND AND THE NRN MID ATLANTIC OVERNIGHT. MEANWHILE...A PERSISTENT CLOSED LOW INVOF THE NRN CA COAST WILL DRIFT ONLY SLOWLY NWD TOWARD SRN ORE...AS WEAK MIDLEVEL RIDGING CONTINUES OVER THE ROCKIES.

**...SE NEW ENGLAND THROUGH THIS EVENING...**

**A SWLY LLJ WILL DEVELOP EWD OVER SE NEW ENGLAND TODAY IN ASSOCIATION WITH A LEAD SPEED MAX EJECTING EWD FROM THE UPPER OH VALLEY...AND IN ADVANCE OF THE LARGER-SCALE LOW OVER ONTARIO. VERY MOIST PROFILES...WITH WIDESPREAD CLOUDS AND POOR LAPSE RATES...IS EXPECTED TODAY ACROSS SE NEW ENGLAND. THIS WILL LIMIT BUOYANCY...THOUGH ANY SUBSTANTIAL CLOUD BREAKS COULD BOOST SURFACE HEATING/INSTABILITY IN AN ENVIRONMENT WITH SUFFICIENT LOW-MIDLEVEL SHEAR AND HODOGRAPH CURVATURE FOR A LOW RISK OF STRONG GUSTS AND/OR A BRIEF/WEAK TORNADO.**

...ERN OK TO WRN KY/TN THIS AFTERNOON...

A CONVECTIVELY-ENHANCED MIDLEVEL TROUGH OVER NW OK THIS MORNING WILL DRIFT ENEWD TO THE SE KS/SW MO BORDER REGION BY TONIGHT. A WEAK COLD FRONT WILL SAG SWD FROM KY/MO TO TN/AR...MODIFIED BY ONGOING CONVECTION. WEAK CONVERGENCE ALONG THE FRONT...ALONG WITH DIFFERENTIAL HEATING ON THE SRN EDGE OF THE CLOUD BAND FROM ERN OK TO KY...WILL SUPPORT ADDITIONAL THUNDERSTORM DEVELOPMENT THIS AFTERNOON AS THE MOIST BOUNDARY LAYER HEATS ALONG AND S OF THE EFFECTIVE FRONT. MODERATE INSTABILITY IS EXPECTED ALONG THE FRONT/DIFFERENTIAL HEATING ZONE...AND VERTICAL SHEAR WILL BE MORE FAVORABLE FOR ORGANIZED STORM CLUSTERS IN THE WEAK NELY FLOW ON THE IMMEDIATE COOL SIDE OF THE FRONT. A FEW DAMAGING GUSTS WILL BE POSSIBLE FROM ERN OK ACROSS NRN AR TO WRN TN...WHERE THE STRONGER INSTABILITY COINCIDES WITH A BELT OF SOMEWHAT ENHANCED MIDLEVEL FLOW ON THE IMMEDIATE SE SIDE OF THE WEAK MIDLEVEL TROUGH.

...NE NM AREA THROUGH EARLY TONIGHT...

A DEPARTING MIDLEVEL TROUGH WILL LEAVE LITTLE LARGE-SCALE FOCUS FOR ASCENT ACROSS NE NM AND VICINITY. STILL...LINGERING LOW-LEVEL MOISTURE IN A WEAK UPSLOPE FLOW REGIME SHOULD SUPPORT AT LEAST WIDELY SCATTERED THUNDERSTORM DEVELOPMENT THIS AFTERNOON ALONG THE E SLOPES OF THE HIGHER TERRAIN. STORMS SHOULD SUBSEQUENTLY MOVE SLOWLY SEWD THROUGH THE EVENING...WITH SOME POTENTIAL FOR ISOLATED LARGE HAIL AND STRONG GUSTS GIVEN MLCAPE OF 1000-1500 J/KG AND EFFECTIVE BULK SHEAR OF 25-30 KT.

...SE MT/NE WY/SW SD TODAY...

A WNW-ESE ORIENTED BAND OF CONVECTION IS WEAKENING THIS MORNING FROM SE MT TO SW SD. HOWEVER...THE BACKGROUND PATTERN OF WEAK LOW-LEVEL FRONTOGENESIS ALONG THIS SAME CORRIDOR WILL PERSIST... AND ADDITIONAL THUNDERSTORM DEVELOPMENT IS EXPECTED THIS AFTERNOON.

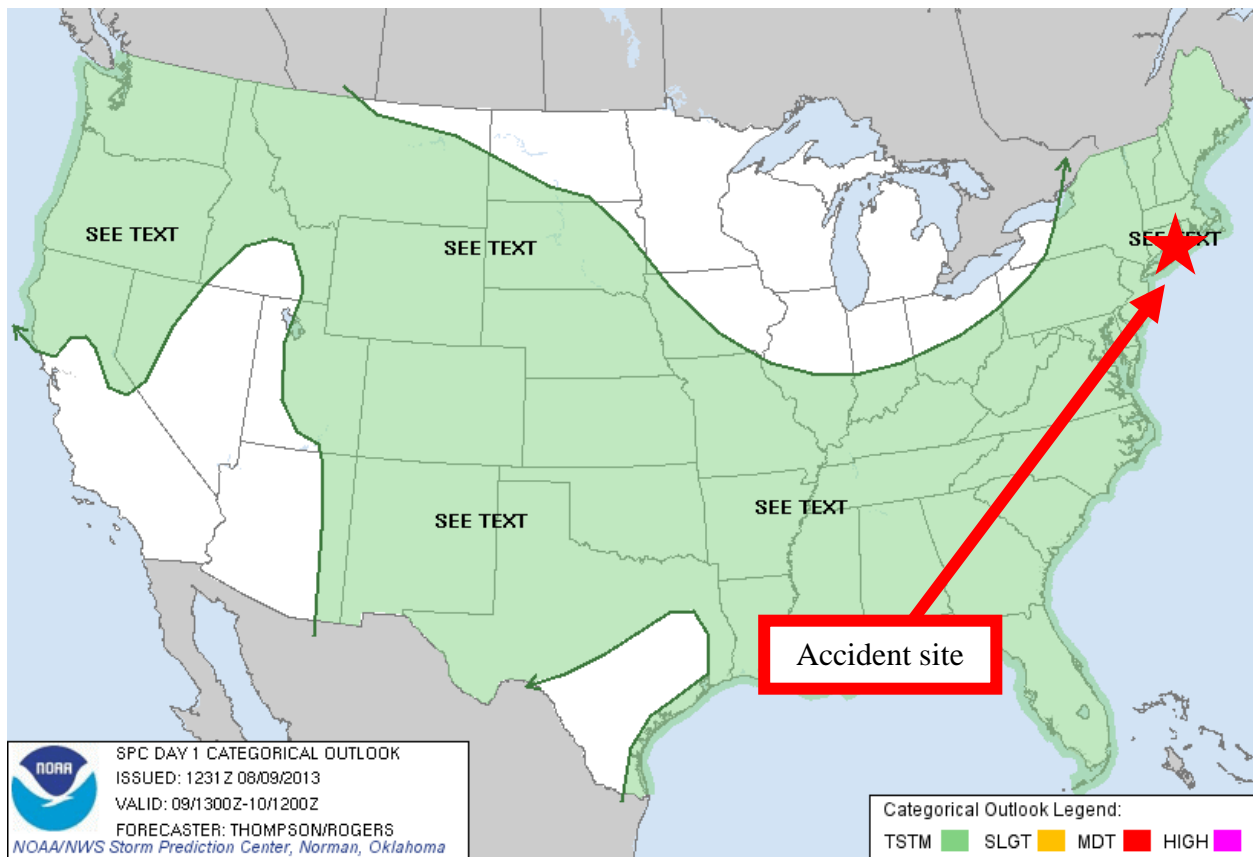
RESIDUAL LOW-LEVEL MOISTURE BENEATH THE NE EDGE OF THE STEEPER MIDLEVEL LAPSE RATES WILL CONTRIBUTE TO WEAK-MODERATE INSTABILITY...WHILE DEEP-LAYER VERTICAL SHEAR WILL BE AT LEAST MARGINALLY FAVORABLE FOR ORGANIZED MULTICELLS AND/OR SUPERCELLS. ISOLATED LARGE HAIL AND DAMAGING GUSTS WILL BE THE MAIN THREATS FOR A FEW HOURS THIS AFTERNOON/EVENING.

...NRN CA TO CENTRAL ORE THIS AFTERNOON/EVENING...  
SUFFICIENT LOW-MIDLEVEL MOISTURE AND ASCENT NE OF THE MIDLEVEL LOW WILL AGAIN PROMOTE THUNDERSTORM DEVELOPMENT THIS AFTERNOON FROM EXTREME N/NE CA INTO CENTRAL ORE. MODEST INSTABILITY AND DEEP-LAYER SELY SHEAR WILL SUPPORT A FEW ORGANIZED CLUSTERS CAPABLE OF PRODUCING ISOLATED STRONG/DAMAGING GUSTS AND MARGINALLY SEVERE HAIL.

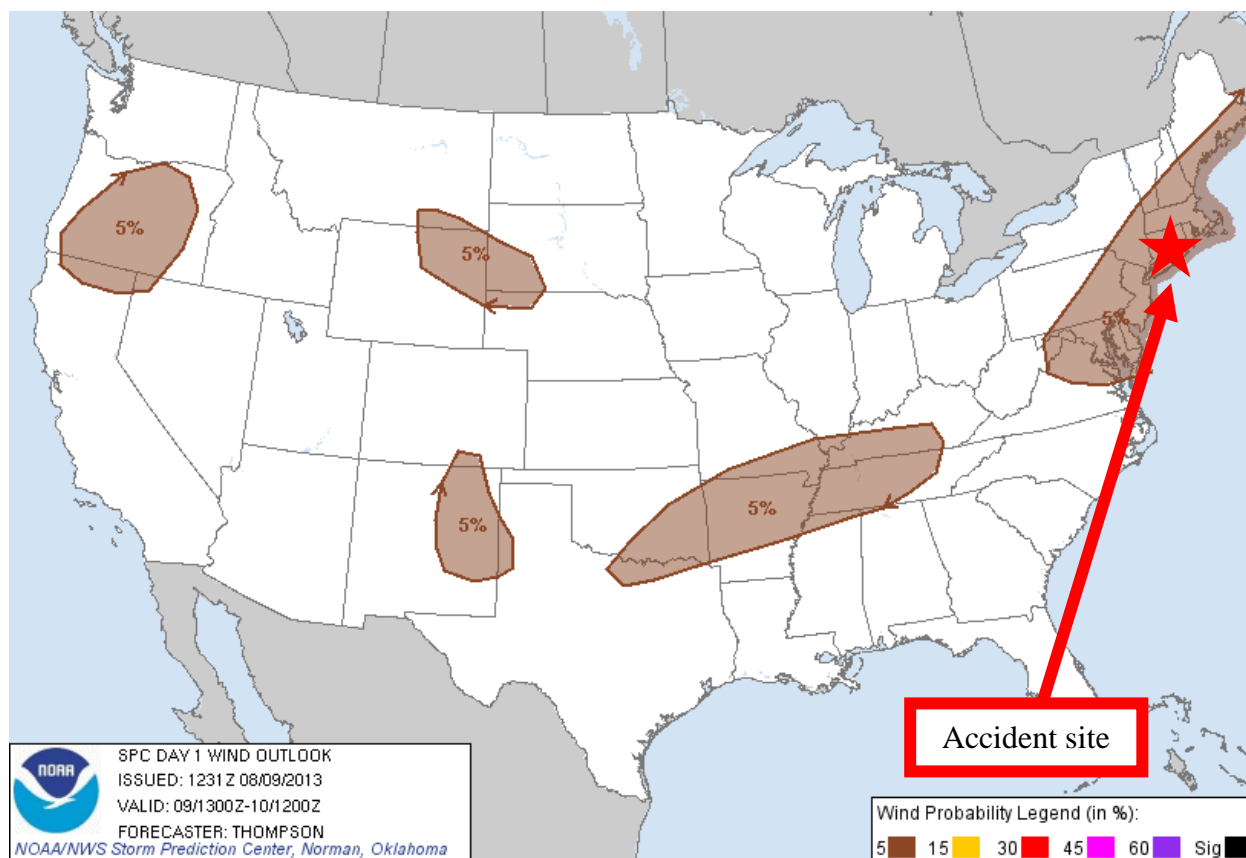
..THOMPSON/ROGERS.. 08/09/2013

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NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 1630Z



**Figure 7 – Storm Prediction Center day 1 Convective Outlook valid at the time of the accident**



**Figure 8 – Storm Prediction Center day 1 probability of damaging thunderstorm winds valid at the time of the accident**

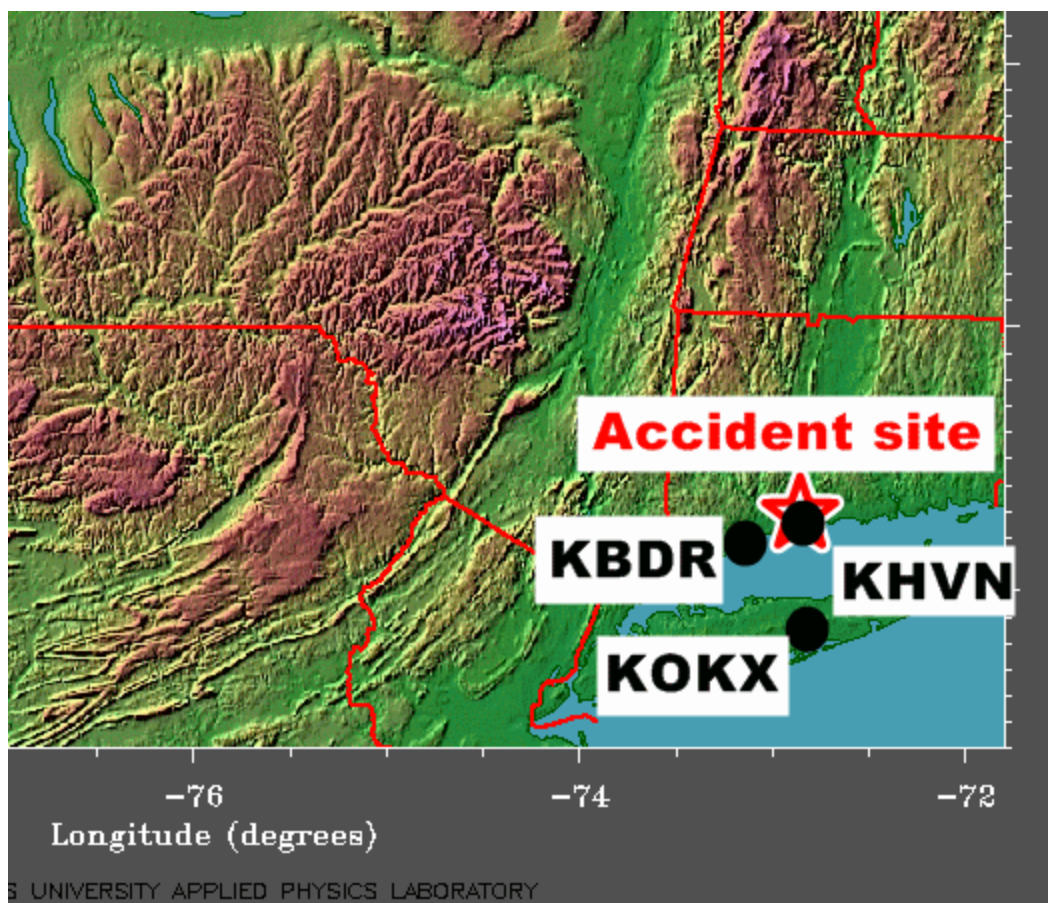


**Figure 9 – Storm Prediction Center day 1 probability of a tornado valid at the time of the accident**

### 3.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language.





**Figure 10 – Map of Connecticut with the location of the accident site, surface observation site, upper air sounding location, and weather radar site**

Tweed-New Haven Airport (KHVN) located 3 miles southeast of New Haven, Connecticut, had an Automated Surface Observing System (ASOS<sup>5</sup>) whose reports were supplemented by air traffic control (figure 10). KHVN was located at an elevation of 12 feet, had a 13° westerly magnetic variation<sup>6</sup>, and was located 1 mile south of the accident site. The following observations were taken and disseminated during the times surrounding the accident:

[0753 EDT] KHVN 091153Z 17009KT 8SM -RA SCT014 BKN100 23/22 A2995  
RMK AO2 SLP143 P0002 60004 70004 T02330222 10233 20233 58012=

[0831 EDT] KHVN 091231Z 18007KT 7SM -RA BKN012 BKN055 OVC100 23/22  
A2995 RMK AO2 P0001=

[0853 EDT] KHVN 091253Z 17009KT 7SM -RA OVC012 23/22 A2994 RMK AO2  
SLP138 P0002 T02330222=

[0946 EDT] KHVN 091346Z 16009KT 10SM BKN009 OVC014 24/23 A2991

<sup>5</sup> ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

<sup>6</sup> Magnetic variation – The angle (at a particular location) between magnetic north and true north.

RMK AO2 RAE41 P0000=

**[0953 EDT] KHAVN 091353Z 16012KT 10SM BKN009 OVC012 24/23 A2991  
RMK AO2 RAE41 SLP126 P0000 T02390228=**

**[1053 EDT] KHAVN 091453Z 17012KT 10SM OVC009 24/23 A2990 RMK AO2  
RAB42E52 CIG 007V014 SLP123 P0000 60002 T02390228 56020=**

**ACCIDENT TIME 1121 EDT**

**[1126 EDT] KHAVN 091526Z 17012G19KT 9SM -RA OVC009 24/23 A2988  
RMK AO2 RAB18 CIG 006V011 P0000=**

**[1153 EDT] KHAVN 091553Z 17014KT 5SM -RA BR BKN009 OVC037 24/23  
A2986 RMK AO2 RAB18 SLP112 P0003 T02390228=**

**[1253 EDT] KHAVN 091653Z 18015KT 5SM BR BKN009 OVC017 24/23 A2983  
RMK AO2 RAE1554 CIG 007V012 SLP101 T02440228=**

**[1353 EDT] KHAVN 091753Z 19010G17KT 6SM BR SCT011 BKN085 26/23  
A2981 RMK AO2 SLP096 60005 T02560233 10256 20233 56017=**

**[1453 EDT] KHAVN 091853Z 20005KT 4SM -RA BR SCT037 BKN070 OVC085  
25/23 A2981 RMK AO2 RAB33 SLP094 P0000 T02500228=**

**[1553 EDT] KHAVN 091953Z VRB06KT 9SM BR SCT020 OVC038 26/23 A2980=**

KHAVN weather at 0953 EDT, wind from 160° at 12 knots, 10 miles visibility, a broken ceiling at 900 feet above ground level (agl), overcast skies at 1,200 feet agl, temperature of 24° Celsius (C), dew point temperature of 23° C, and an altimeter setting of 29.91 inches of mercury. Remarks: automated station with precipitation discriminator, rain ended at 0941 EDT, sea level pressure 1012.6 hPa, one-hourly precipitation of a trace, temperature of 23.9° C, dew point temperature of 22.8° C.

KHAVN weather at 1053 EDT, wind from 170° at 12 knots, 10 miles visibility, an overcast ceiling at 900 feet agl, temperature of 24° C, dew point temperature of 23° C, and an altimeter setting of 29.90 inches of mercury. Remarks: automated station with precipitation discriminator, rain began at 1042 EDT and ended at 1052 EDT, ceiling variable between 700 and 1,400 feet agl, sea level pressure 1012.3 hPa, one-hourly precipitation of a trace, 6-hourly precipitation of 0.02 inches, temperature of 23.9° C, dew point temperature of 22.8° C, 3-hourly pressure decrease of 2.0 hPa.

KHAVN weather at 1126 EDT, wind from 170° at 12 knots with gusts to 19 knots, 9 miles visibility, light rain, an overcast ceiling at 900 feet agl, temperature of 24° C, dew point temperature of 23° C, and an altimeter setting of 29.88 inches of mercury. Remarks: automated



station with precipitation discriminator, rain began at 1118 EDT, ceiling variable between 600 and 1,100 feet agl, one-hourly precipitation of a trace.

KHVN weather at 1153 EDT, wind from 170° at 14 knots, 5 miles visibility, light rain and mist, a broken ceiling at 900 feet agl, overcast skies at 3,700 feet agl, temperature of 24° C, dew point temperature of 23° C, and an altimeter setting of 29.86 inches of mercury. Remarks: automated station with precipitation discriminator, rain began at 1118 EDT, sea level pressure 1011.2 hPa, one-hourly precipitation of 0.03 inches, temperature of 23.9° C, dew point temperature of 22.8° C.

### **3.1 One Minute Wind Observations**

The one-minute KHVN ASOS surface data was provided by the NWS for the time surrounding the accident. One-minute raw wind data was provided with two separate magnitudes and wind directions<sup>7</sup>. The first wind data in table 1 is the two-minute average wind speed, which was updated every 5 seconds and reported once a minute. The second source of one-minute wind data is the five-second maximum wind average, which was updated every five seconds and reported once every minute (table 1). The following table provides the meteorological data in local time (EST)<sup>8</sup> as well as UTC time.

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<sup>7</sup> The wind directions are in reference to true north.

<sup>8</sup> The one-minute wind observations from an ASOS are not automatically reported in daylight time.

Time (EST)	Time (UTC)	Dir of 2min avg wind	Speed of 2 min avg wind (knots)	Dir of max 5 sec avg wind	Speed of max 5 sec avg wind (knots)
1003	1503	172	12	179	16
1004	1504	176	12	177	14
1005	1505	177	11	171	15
1006	1506	176	10	189	12
1007	1507	174	10	175	14
1008	1508	173	11	178	14
1009	1509	174	12	167	15
1010	1510	175	12	185	15
1011	1511	175	12	174	15
1012	1512	174	11	184	12
1013	1513	174	12	177	17
1014	1514	171	13	180	18
1015	1515	172	14	179	18
1016	1516	175	14	168	17
1017	1517	176	13	175	15
1018	1518	176	11	172	14
1019	1519	173	12	169	17
<b>1020</b>	<b>1520</b>	<b>172</b>	<b>13</b>	<b>163</b>	<b>19</b>
<b>1021</b>	<b>1521</b>	<b>175</b>	<b>11</b>	<b>175</b>	<b>13</b>
<b>1022</b>	<b>1522</b>	<b>174</b>	<b>12</b>	<b>170</b>	<b>17</b>
1023	1523	174	14	183	16
1024	1524	171	13	164	17
1025	1525	170	13	168	16
1026	1526	171	12	158	16
1027	1527	174	11	179	17
1028	1528	175	12	177	16
1029	1529	174	11	176	14
1030	1530	175	11	175	14
1031	1531	178	12	184	16
1032	1532	179	12	181	15
1033	1533	178	12	174	18
1034	1534	178	13	173	17
1035	1535	178	14	176	18
1036	1536	181	13	195	16

**Table 1 – One-minute KHVN ASOS data for the time surrounding the accident**

At 1120 EDT, KHAVN reported the two-minute average wind from 172° at 13 knots and a five-second maximum average wind from 163° at 19 knots.

At 1121 EDT, KHAVN reported the two-minute average wind from 175° at 11 knots and a five-second maximum average wind from 175° at 13 knots.

At 1122 EDT, KHAVN reported the two-minute average wind from 174° at 12 knots and a five-second maximum average wind from 170° at 17 knots.

#### **4.0 Upper Air Data**

The closest official upper air sounding to the accident site was from Brookhaven, New York (KOKX), which was approximately 25 miles south of the accident site, with a site number 72501, and a station elevation of 66 feet (figure 10). The 0800 EDT sounding from KOKX was plotted on a standard Skew-T log P diagram<sup>9</sup> with the derived stability parameters included in figure 11 (with data from the surface to 700-hPa, or 10,000 feet msl). This data was analyzed utilizing the RAOB<sup>10</sup> software package. The sounding depicted a moist vertical environment with the Lifted Condensation Level (LCL)<sup>11</sup> at 363 feet msl, a Convective Condensation Level (CCL)<sup>12</sup> of 2,606 feet, and a Level of Free Convection (LFC)<sup>13</sup> at 822 feet. The freezing level was located at 14,920 feet msl. The precipitable water value was 2.19 inches.

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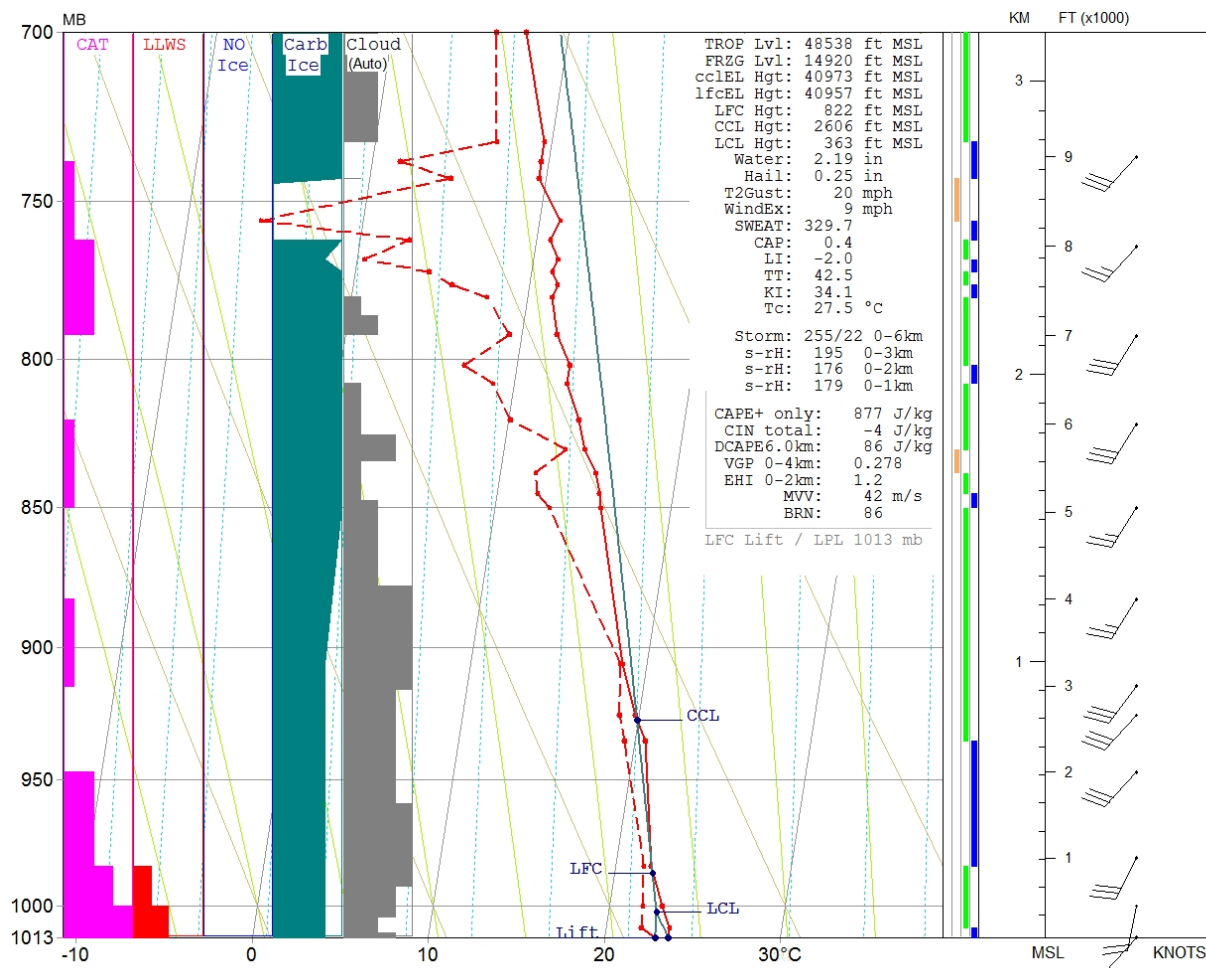
<sup>9</sup> Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

<sup>10</sup> RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

<sup>11</sup> Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

<sup>12</sup> Convective Condensation Level (CCL) – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

<sup>13</sup> Level of Free Convection (LFC) – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.



**Figure 11 – 0800 EDT KOKX sounding**

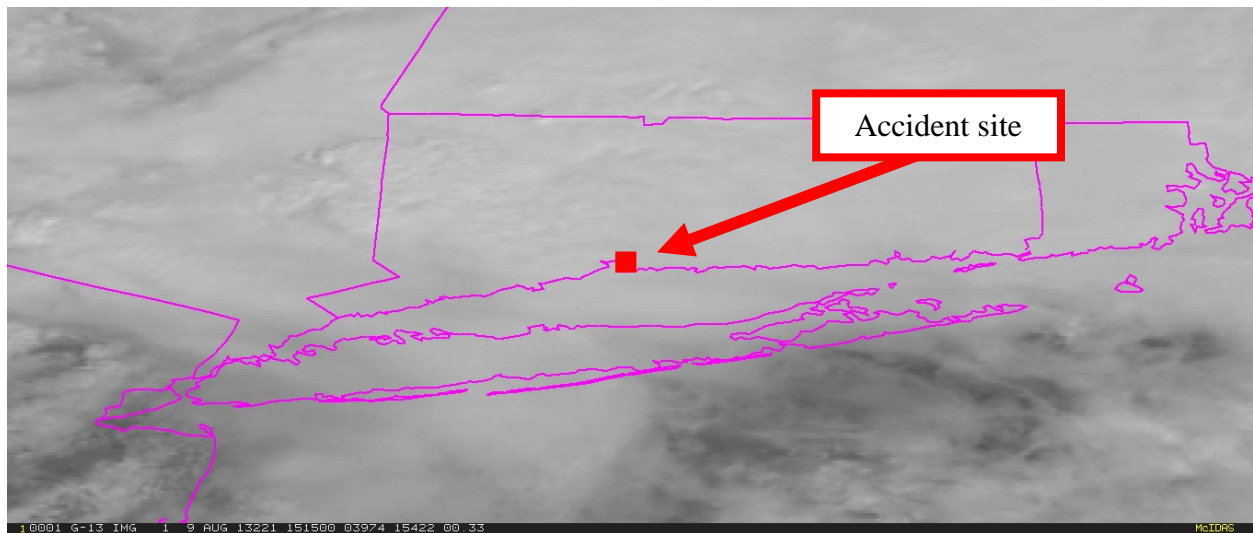
The 0800 EDT KOKX sounding indicated a moist conditionally unstable vertical environment from the surface through 10,000 feet msl with an area of decreased moisture between 5,000 and 9,000 feet msl. This environment would have been conducive of cloud formation as indicated by RAOB, especially from surface through 5,000 feet. No icing was indicated by RAOB.

The sounding wind profile indicated there was a surface wind from 220° at 2 knots and the wind increased to 19 knots by 438 feet msl with the wind increasing to 30 knots by 901 feet msl. Low-level wind shear (LLWS) was indicated by RAOB between the surface and 1,200 feet msl. Several layers of clear-air turbulence were identified by RAOB from the surface through 9,000 feet.

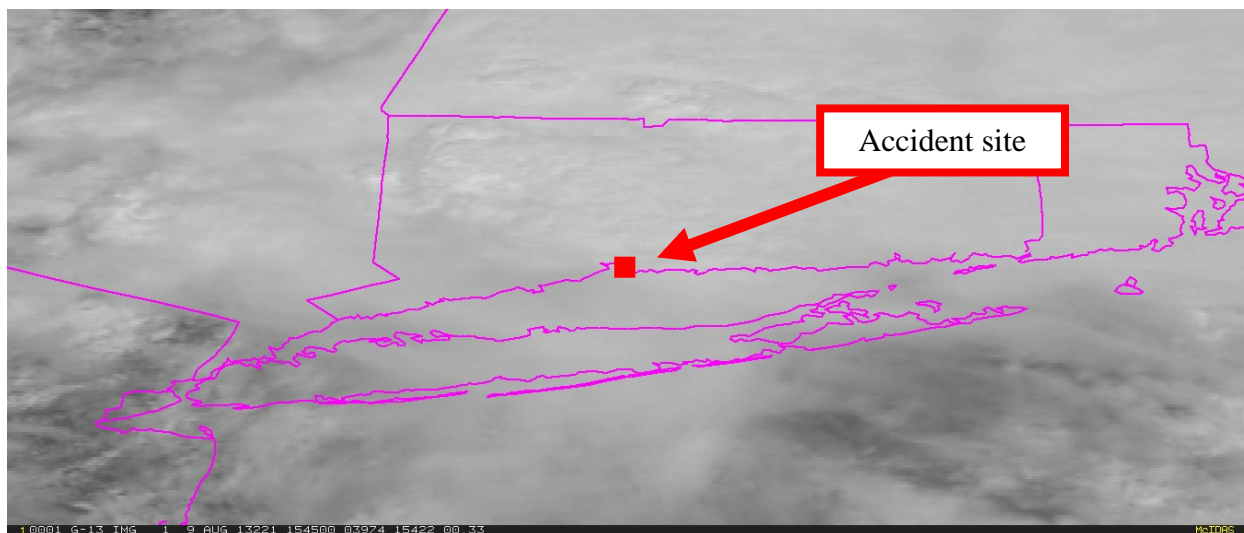
## 5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from the NCDC and processed with the NTSB's Man-computer Interactive Data Access System (McIDAS) workstation. The visible and infrared imagery (GOES-13, band 1 and 4), at wavelengths of 0.65 microns ( $\mu\text{m}$ ) and 10.7  $\mu\text{m}$  were retrieved for the scene. Satellite imagery surrounding the time of the accident, from 0900 EDT through 1300 EDT at approximately 15-minute intervals, were reviewed and the closest images to the time of the accident are documented here.

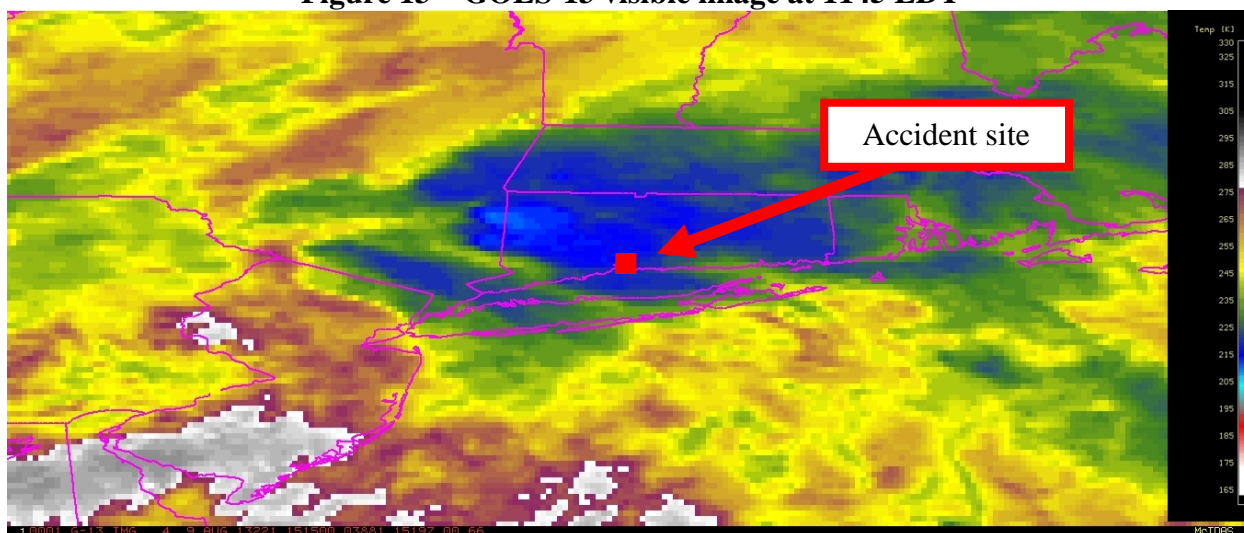
Figures 12 and 13 present the GOES-13 visible imagery from 1115 and 1145 EDT at 3X magnification with the accident site highlighted with a red square. Inspection of the visible imagery indicated cloud cover moving from southwest to northeast over the accident site around the accident time. Figure 14 presents the GOES-13 infrared imagery from 1115 EDT at 6X magnification. The infrared imagery indicated a large amount of high cloud cover (lower brightness temperatures) over and around the accident site at the accident time. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 0800 EDT KOKX sounding, the approximate cloud-top heights over the accident site were 41,000 feet at 1115 EDT.



**Figure 12 – GOES-13 visible image at 1115 EDT**



**Figure 13 – GOES-13 visible image at 1145 EDT**



**Figure 14 – GOES-13 infrared image at 1115 EDT**

## 6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D) was KOKX. Level II archive radar data was obtained from the NCDC utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

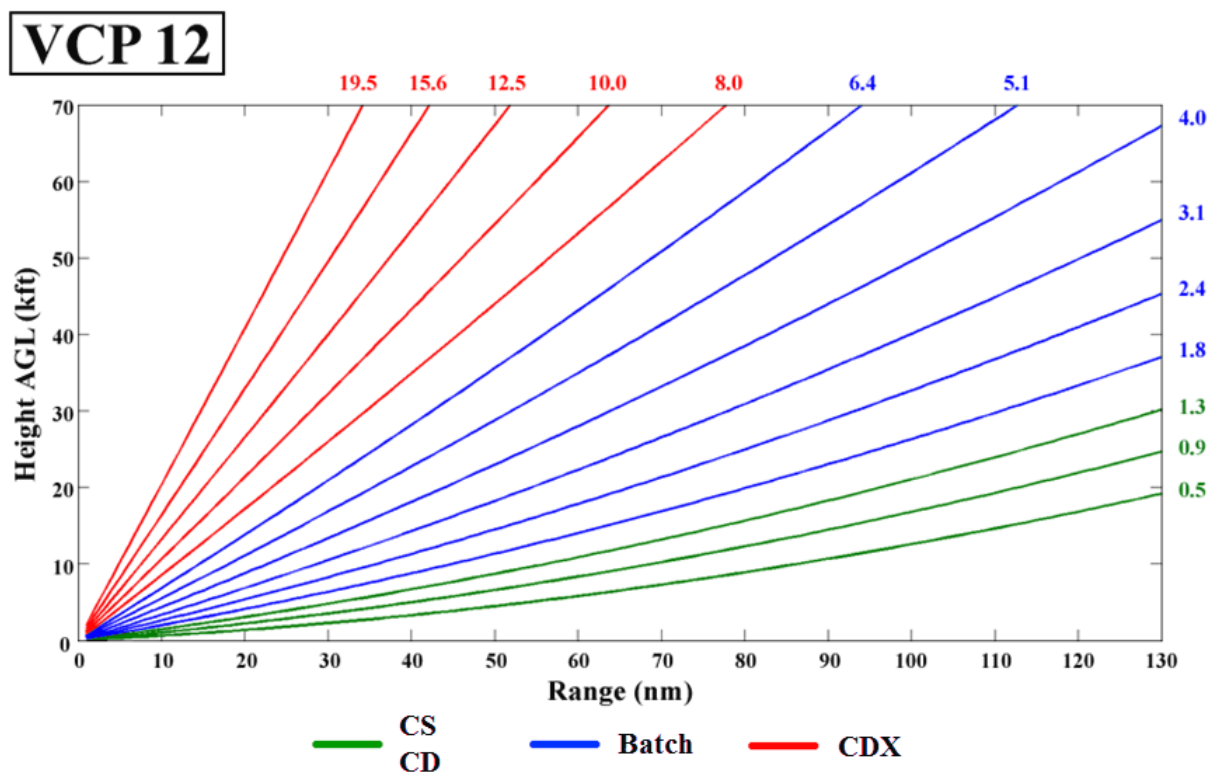
The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width<sup>14</sup>. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

<sup>14</sup> Beam width – A measure of the angular width of a radar beam.

## 6.1 Volume Scan Strategy

The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP). Products that require data from multiple elevation scans are not available until the end of the five to ten minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 14 elevation scans from 0.5° to 19.5° every four and a half minutes. This particular scanning strategy is documented as volume coverage pattern 12 (VCP-12). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten minute period. During the period surrounding the accident, the KOKX WSR-88D radar was operating in the precipitation mode (Mode A, VCP-12). The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



VCP-12 Precipitation Mode Scan Strategy

## 6.2 Beam Height Calculation

Assuming standard refraction<sup>15</sup> of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width information<sup>16</sup> of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	1,850 feet	620 feet	3,090 feet	2,470 feet

Based on the radar height calculations, the 0.5° elevation scan depicted the conditions between 620 feet and 3,090 feet msl over the accident site.

---

<sup>15</sup> Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

<sup>16</sup> Beamwidth values are shown for legacy resolution products. Super resolution products would an effective beamwidth that would be approximately half these values.



### 6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors<sup>17</sup> it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ<sup>18</sup>), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

**NWS VIP/DBZ CONVERSION TABLE**

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1 Very Light	3	15 to 19	.01 in/hr
	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2 Light to Moderate	6	30 to 34	.09 in/hr
	7	35 to 39	.21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11	55 to 59	>5.67 in/hr
	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

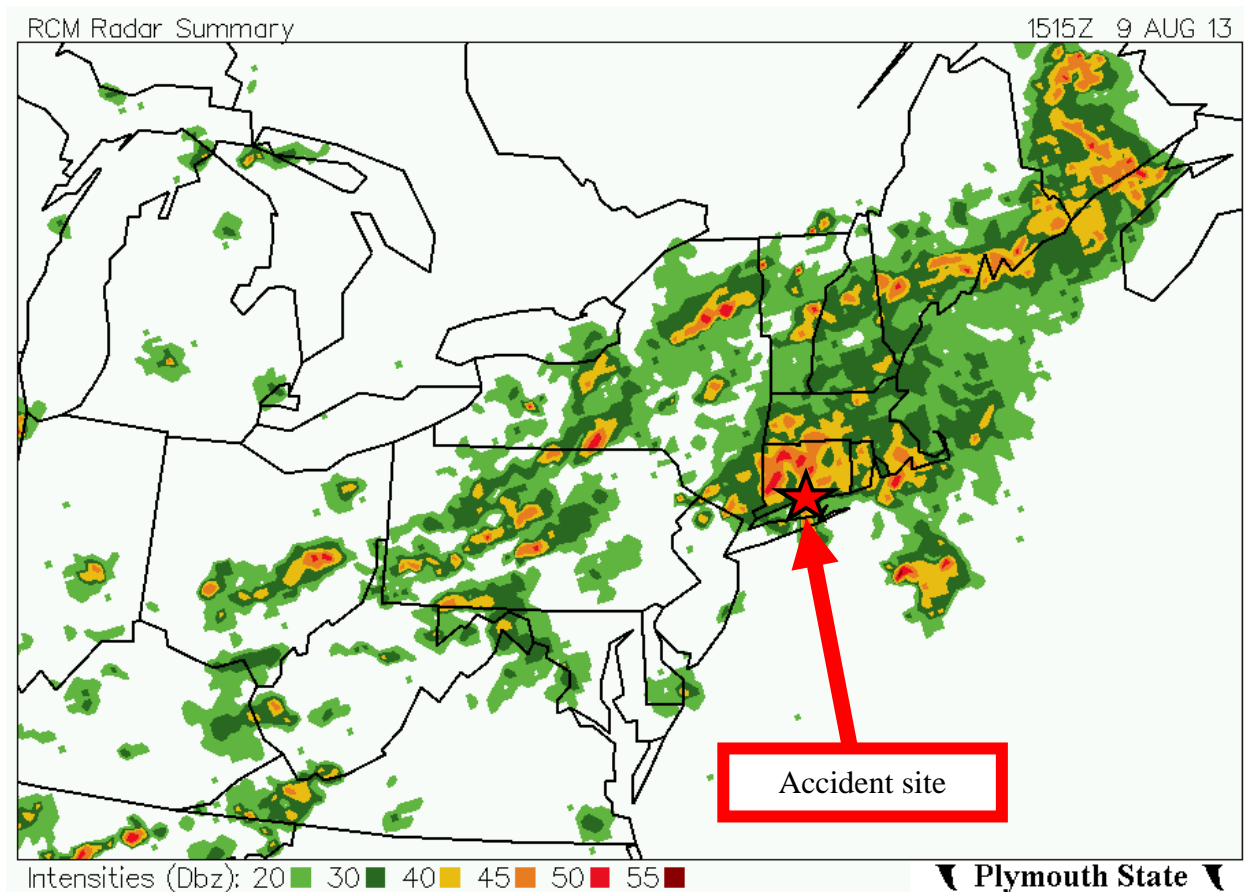
<sup>17</sup> Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glazed ice.

<sup>18</sup> dBZ – A non-dimensional “unit” of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

The Federal Aviation Administration (FAA) Advisory Circular AC 00-24B titled “Thunderstorms” dated January 2, 1983, also defines the echo intensity levels and potential weather phenomena associated with those levels. If the maximum VIP Level is 1 “weak” and 2 “moderate”, then light to moderate turbulence is possible with lightning. VIP Level 3 is “strong” and severe turbulence is possible with lightning. VIP Level 4 is “very heavy” and severe turbulence is likely with lightning. VIP Level 5 is “intense” with severe turbulence, lightning, hail likely, and organized surface wind gusts. VIP Level 6 is “extreme” with severe turbulence, lightning, large hail, extensive surface wind gusts and turbulence.

#### 6.4 Radar Summary

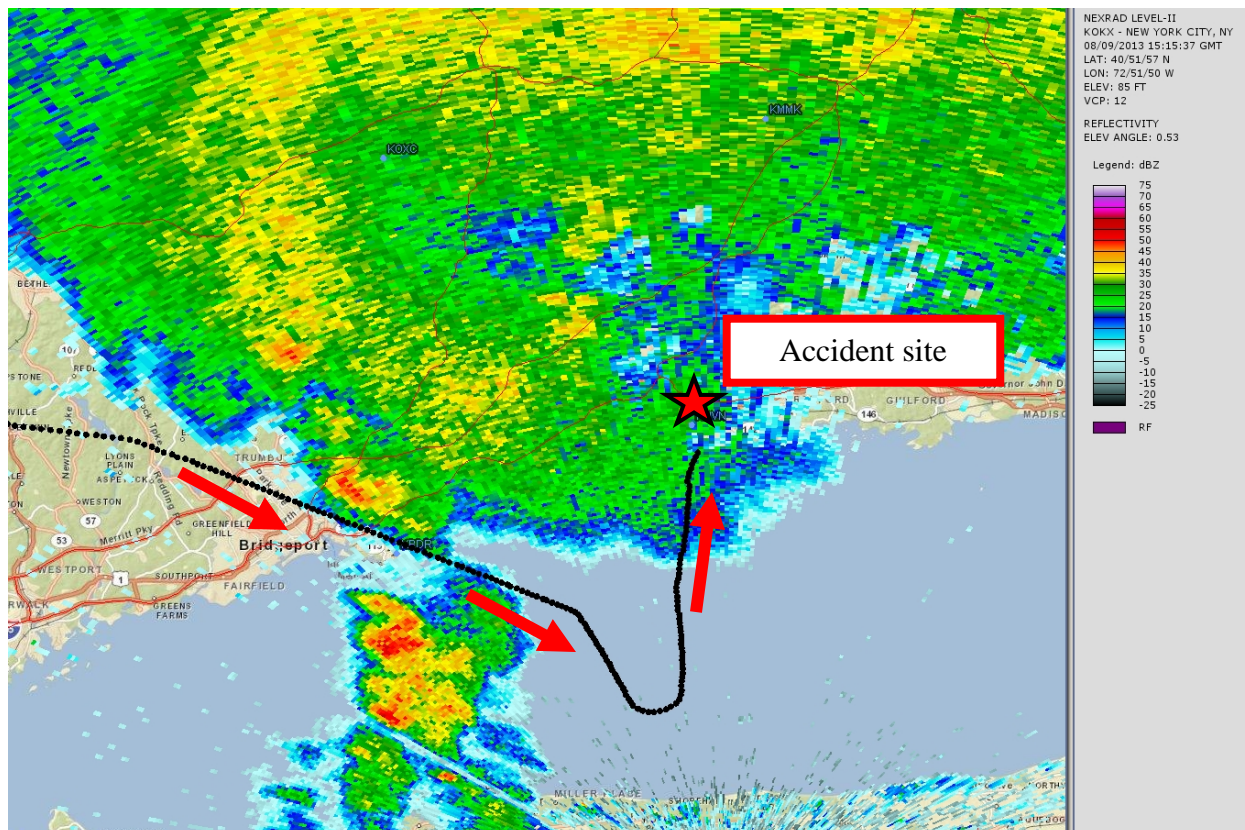
Figure 15 provides a radar summary image from 1115 EDT with reflectivity values over the northeastern United States, with the accident site located in an area of 30 to 50 dBZ values. These reflectivity values indicate light to intense echoes near the accident site around the accident time.



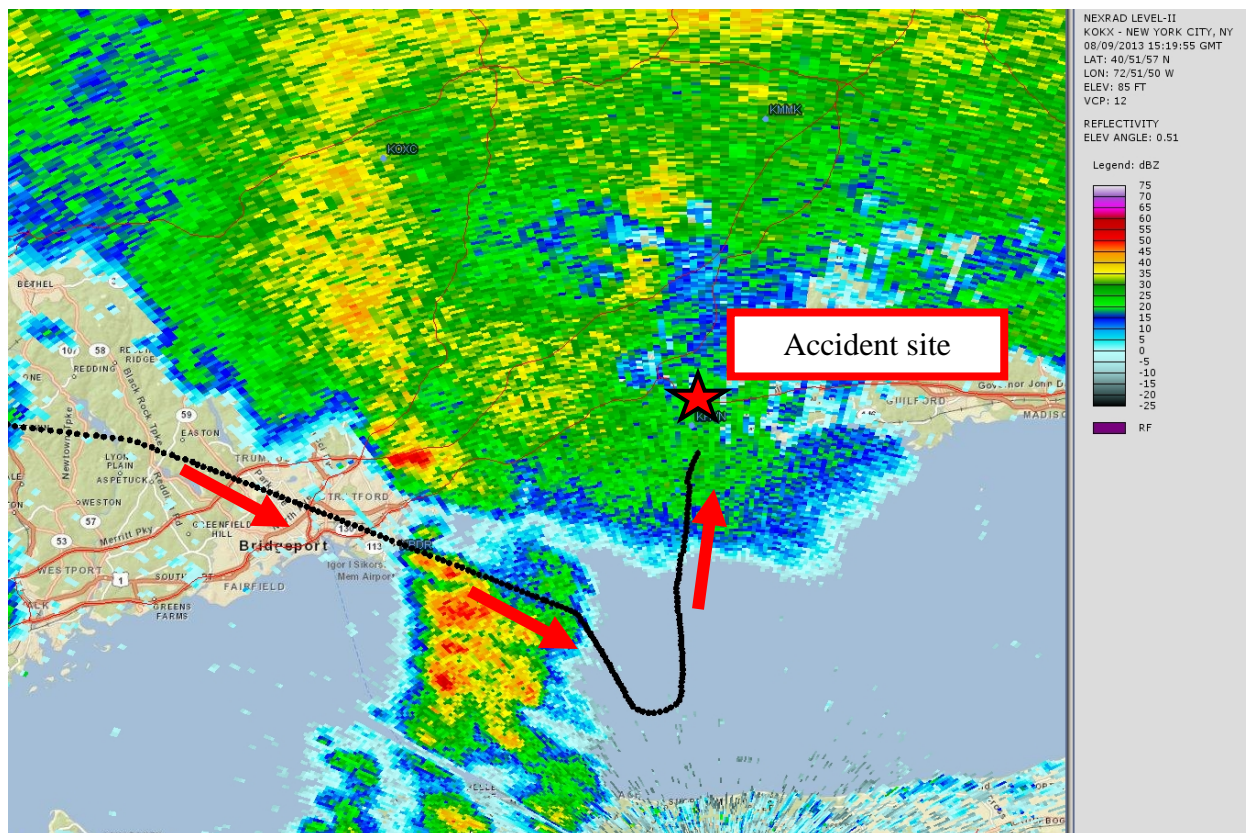
**Figure 15 – Radar summary image for 1115 EDT with the accident site**

## 6.5 Base Reflectivity and Lightning Data

Figures 16 through 18 present the KOKX WSR-88D base reflectivity image for the 0.5° elevation scans initiated at 1115, 1120, and 1124 EDT with a resolution of 0.5° X 250 m. 20 to 30 dBZ reflectivity values occurred along the last part of the route of flight which indicated very light to moderate echoes. The precipitation echoes can be seen moving from west-southwest to east-northeast between 1115 and 1124 EDT increasing in coverage near and around the accident site. Lightning data was reviewed around the accident time and there were no lightning strikes near the accident site at the accident time.

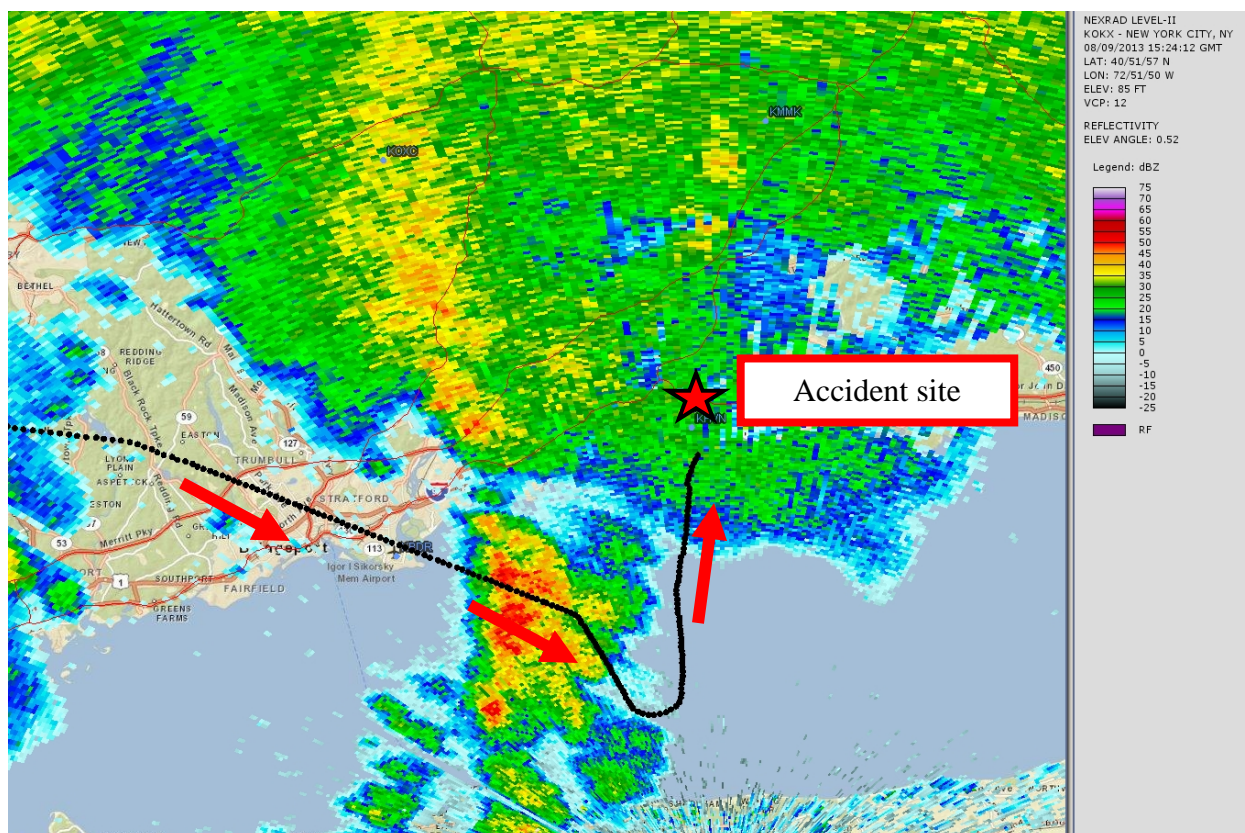


**Figure 16 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1115 EDT with ATC flight track points**



**Figure 17 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1120 EDT with ATC flight track points**





**Figure 18 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1124 EDT with ATC flight track points**

## 7.0 Pilot Reports

Pilot reports (PIREPs) were reviewed close to the accident site from around three hours prior to the accident time to around three hours after the accident time and these PIREPs were disseminated near the accident aircraft's flight altitude:

BDL UA /OV BDL270010 /TM 1435 /FL060 /TP C510 /TB MOD=

FRG UUA /OV FRG /TM 1812 /FL010 /TP GLF5 /RM LLWS +/-15KT 010/BLO FAP RY 19 FRG GAIN 5-15KT=

Routine pilot report (UA); 10 miles from Windsor Locks, Connecticut, on the 270° radial; Time – 1035 EDT (1435Z); Altitude – 6,000 feet msl; Type aircraft – Cessna C510 Mustang; Turbulence – Moderate.

Urgent pilot report (UUA); Over Farmingdale, New York,; Time – 1412 EDT (1812Z); Altitude – 1,000 feet msl; Type aircraft – Gulfstream V; Remarks – LLWS +/- 15 knots at 1,000 feet; below final approach point on runway 19 at Farmingdale gain of 5 to 15 knots.

## 8.0 SIGMET and CWSU Advisory

SIGMET 41E was valid for the first part of the accident flight at the accident time. The SIGMET advised of a developing area of embedded thunderstorms moving from 240° at 25 knots. Thunderstorm tops were forecast to FL420<sup>19</sup>:

CONVECTIVE SIGMET 41E  
VALID UNTIL 1655Z  
MA CT NY  
**FROM 30NW BDL-10S BDL-20NE SAX-40E HNK-30NW BDL  
DVLPG AREA EMBD TS MOV FROM 24025KT. TOPS TO FL420.**

No CWSU Advisory (CWA) was valid for the accident site at the accident time.

No Meteorological Impact Statement (MIS) was valid for the accident site at the accident time.

## 9.0 AIRMETs

AIRMETs Tango, Sierra, and Zulu were valid for the accident site at the accident time. They were issued at 1045 EDT and forecasted IFR<sup>20</sup> conditions with ceilings below 1,000 feet and visibility below 3 miles in precipitation and mist, moderate icing between 15,000 feet msl and FL240, and moderate turbulence below 10,000 feet msl:

WAUS41 KPCI 091445  
WA1S  
\_BOSS WA 091445  
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 092100  
.  
**AIRMET IFR...ME NH VT MA RI CT NY NJ PA AND CSTL WTRS  
FROM 70NW PQI TO 60NE PQI TO 110SSW YSJ TO 20ESE ACK TO JFK TO  
30N ETX TO MSS TO YSC TO 70NW PQI  
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.**  
.  
AIRMET IFR...NY LO PA OH LE WV MD VA  
FROM MSS TO 30N ETX TO 30WNW CSN TO HNN TO CVG TO 40SSE FWA TO  
20NNW ERI TO MSS  
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS ENDG 18-21Z.  
.  
AIRMET MTN OBSCN...ME NH VT MA NY PA  
FROM 50N PQI TO MLT TO CON TO HNK TO MSS TO YSC TO 70NW PQI TO  
50N PQI  
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.  
.  
AIRMET MTN OBSCN...NY PA WV MD VA  
FROM MSS TO HNK TO HAR TO 20W CSN TO 50SSW PSK TO HNV TO HNN TO

---

<sup>19</sup> Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

<sup>20</sup> Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 feet agl and/or less than 3 miles visibility.

EWC TO JHW TO MSS  
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.  
.  
OTLK VALID 2100-0300Z...IFR ME NH VT MA RI CT NY AND CSTL WTRS  
BOUNDED BY 70NW PQI-60NE PQI-160ENE ACK-40E ACK-40SSE PVD-20NNW  
HTO-30SE MPV-YSC-70NW PQI  
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 03Z.

....  
WAUS41 KKCI 091445  
WA1Z  
\_BOSZ WA 091445  
AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 092100  
.

**AIRMET ICE...ME NH VT MA RI CT NY LO NJ PA LE AND CSTL WTRS  
FROM 70NW PQI TO 60NE PQI TO 140E ACK TO 20SE ACK TO 20SE ETX TO  
40E AIR TO 50NE YYZ TO YOW TO YSC TO 70NW PQI  
MOD ICE BTN 150 AND FL240. CONDS CONTG BYD 21Z ENDG 00-03Z.**

FRZLVL...RANGING FROM 120-155 ACRS AREA

....  
WAUS41 KKCI 091445  
WA1T  
\_BOST WA 091445  
AIRMET TANGO UPDT 2 FOR TURB VALID UNTIL 092100  
.

**AIRMET TURB...ME NH VT MA RI CT NY NJ PA MD DE AND CSTL WTRS  
FROM 60NE PQI TO 140E ACK TO 30E SBY TO SAX TO 40ENE MPV TO 60NE  
PQI  
MOD TURB BLW 100. CONDS CONTG BYD 21Z THRU 03Z.**

....

## 10.0 Terminal Aerodrome Forecast

Igor I Sikorsky Memorial Airport (KBDR) located in Bridgeport, Connecticut, was located 13 miles southwest of the accident site (figure 10) and was the closest site with a NWS TAF. The TAF valid at the time of the accident was issued at 1037 EDT and was valid for a 21-hour period beginning at 1100 EDT. The TAF forecast for KBDR was as follows:

TAF AMD KBDR 091437Z 0915/1012 18012KT 6SM BR VCSH BKN015 BKN120  
**FM091500 18014KT 6SM -SHRA SCT009 BKN012**  
FM091800 20015G20KT 6SM -SHRA BKN015 OVC030  
TEMPO 0921/1001 3SM -SHRA  
FM100100 24007KT 5SM BR BKN025 BKN050  
FM100400 28007KT P6SM SCT025 BKN050  
FM100700 33005KT P6SM SCT120  
AMD NOT SKED=

The forecast expected a wind from 180° at 14 knots, 6 miles visibility, light rain showers, scattered clouds at 900 feet agl, and a broken ceiling at 1,200 feet agl.

## 11.0 Area Forecast

The Area Forecast issued at 0445 EDT forecasted an overcast ceiling at 2,000 feet msl with the cloud tops at FL350. Occasional visibility between 3 and 5 miles with mist was forecast with widely scattered light rain showers and thunderstorms. Cumulonimbus tops to FL390:

FAUS41 KPCI 090845

FA1W

\_BOSC FA 090845

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 100300

CLDS/WX VALID UNTIL 092100...OTLK VALID 092100-100300

ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC DE VA AND CSTL WTRS

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.

TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HGTS DENOTED BY AGL OR CIG.

SYNOPSIS...AT 09Z...STNR FNT SRN QUE-MSS-ERI-CVG SW THRU AR/MO  
BDR. WRMFNT S ACRS CNTRL ME. TROF EXTDS S OF FNT THRU CNTRL MD-N  
CNTRL SC. BY 03Z...SFC LOW SRN QUE WITH CDFNT N CNTRL VT-SERN  
NY-SW OH BECMG STNR TO SERN MO. WKNG WRMFNT N CNTRL VT-SWRN ME  
AND SE INTO ATLC. TROF WRN CT-CNTRL MD-WRN NC. NEW CDFNT POISED  
TO ENTER FCST AREA ERN LH-NW IN.

ME NH VT

NWRN 1/2 ME/NRN NH...BKN-OVC020 TOP FL210. OCNL VIS 3-5SM BR.

WDLY SCT -TSRA. CB TOPS FL370. OTLK...IFR CIG TSRA BR.

SERN 1/2 ME...BKN-OVC010 TOP FL210. OCNL VIS 3-5SM BR. ISOL

-TSRA. 12Z WDLY SCT -TSRA. CB TOPS FL370. OTLK...IFR CIG TSRA BR.

RMNDR NH/VT...OVC050 TOP FL350. OCNL VIS 3-5SM BR. WDLY SCT

-TSRA. CB TOPS FL390. 12Z BKN020 VIS OCNL 3-5SM -RA BR. SCT

-TSRA. OTLK...IFR CIG RA TSRA BR BECMG 23Z VT MVFR CIG BR.

MA RI CT

**WRN MA/WRN CT...OVC020 TOP FL350. OCNL VIS 3-5SM BR. WDLY SCT  
-SHRA/-TSRA. CB TOPS FL390. 17Z OVC025. WDLY SCT -TSRA BECMG 19Z  
ISOL -SHRA. OTLK...MVFR CIG BR.**

RMNDR...BKN-OVC010 TOP FL350. OCNL VIS 3-5SM BR. 12Z ISOL -TSRA.

CB TOPS FL390. BECMG 1517 OVC020. OTLK...MVFR CIG TSRA BR.

NY LO

SERN CSTL PLAINS...BKN010 TOP FL360. OCNL VIS 3-5SM BR. WDLY SCT

-TSRA. CB TOPS FL390. 17Z BKN020 OVC030. WDLY SCT -TSRA.

OTLK...MVFR CIG TSRA BR.

RMNDR ERN 1/2 NEW YORK...SCT020 OVC030 TOP FL350. OCNL VIS 3-5SM  
BR. WDLY SCT -TSRA. CB TOPS FL410. OTLK...MVFR CIG TSRA BR BECMG  
00Z VFR.

WRN 1/2 NY/LO...BKN030 BKN-OVC100 TOP FL300. ISOL -TSRA. BECMG

1618 SCT050 WITH BKN CI ABV. OTLK...VFR.

PA NJ

SERN PA/SRN NJ...SCT010 BKN-OVC020 TOP FL350. WDLY SCT -TSRA. CB

TOPS FL390. 15Z BKN040. SCT -TSRA. OTLK...VFR TSRA.

RMNDR ERN PA/NRN NJ...SCT020 BKN030 TOP FL350. OCNL BKN020 VIS



3-5SM BR. WDLY SCT -TSRA. CB TOPS FL390. OTLK...MVFR CIG TSRA BR.  
WRN PA...BKN025 OVC040 TOP FL270. ISOL -TSRA. CB TOPS FL390. 15Z  
WDLY SCT -TSRA. 17Z BKN060. ISOL -SHRA. OTLK...VFR.

.  
OH LE

ERN AND N CNTRL OH/LE...OVC020 TOP FL290. OCNL VIS 3-5SM -RA BR.  
WDLY SCT -TSRA. CB TOPS FL400. BECMG 1719 BKN040. ISOL -SHRA.  
OTLK...VFR.

NWRN OH...BKN030 OVC050 TOP FL280. OCNL VIS 3-5SM -RA BR. WDLY  
SCT -TSRA. CB TOPS FL400. 16Z BKN CI. OTLK...VFR.  
RMNDR...BKN020 BKN060 TOP FL340. OCNL VIS 3-5SM -RA BR. WDLY SCT  
-TSRA. CB TOPS FL400. BECMG 1416 SCT030 BKN090. ISOL -TSRA ENDG  
20Z. OTLK...VFR.

.  
WV

APLCNS...OVC035 TOP FL180. OCNL VIS 3-5SM -RA BR. ISOL -TSRA. CB  
TOPS FL450. BECMG 1618 BKN-OVC050. WDLY SCT -TSRA. OTLK...MVFR  
CIG RA TSRA BR BECMG 00Z VFR TSRA.  
RMNDR...BKN030 TOP FL250. OCNL VIS 3-5SM BR. ISOL -TSRA. CB TOPS  
FL450. BECMG 1416 OVC040. WDLY SCT -TSRA. OTLK...MVFR CIG TSRA BR  
BECMG 00Z VFR.

.  
MD DC DE VA

APLCNS...OVC035 TOP FL240. OCNL VIS 3-5SM BR. ISOL -SHRA/-TSRA.  
CB TOPS FL470. BECMG 1618 BKN-OVC070. WDLY SCT -TSRA. OTLK...VFR  
TSRA.  
SE VA...SCT040 OVC150 TOP FL250. ISOL -SHRA/-TSRA. CB TOPS FL470.  
BECMG 1618 BKN040 OVC150. WDLY SCT -TSRA. OTLK...VFR -TSRA.  
RMNDR AREA...SCT050 BKN-OVC070 TOP FL250. ISOL -SHRA/-TSRA. CB  
TOPS FL470. BECMG 1416 WDLY SCT -TSRA. OTLK...VFR TSRA BECMG 01Z  
VFR.

.  
CSTL WTRS

N OF ACK...BKN-OVC010 TOP FL350. OCNL VIS 3-5SM BR. 12Z ISOL  
-TSRA. CB TOPS FL390. BECMG 1517 OVC020. OTLK...MVFR CIG TSRA BR.  
S OF ACK AND E OF 35S PVD...SCT020 BKN CI. BECMG 1214 BKN020 TOP  
FL350. WDLY SCT -TSRA. CB TOPS FL430. OTLK...MVFR CIG TSRA.  
RMNDR...SCT050 BKN-OVC070 TOP FL250. ISOL -SHRA/-TSRA. CB TOPS  
FL470. BECMG 1416 WDLY SCT -TSRA. OTLK...VFR TSRA BECMG 01Z VFR.

....

## 12.0 National Weather Service Area Forecast Discussion

The National Weather Service Office in New York, New York, issued the following Area Forecast Discussion at 1056 EDT which discussed MVFR<sup>21</sup> to LIFR<sup>22</sup> ceiling conditions expected across the area through the afternoon hours with the precipitation. More amendments to the TAFs were expected in the afternoon due to the uncertainty in where the convection would develop:

---

<sup>21</sup> Marginal Visual Flight Rules (MVFR) – Refers to the general weather conditions pilots can expect at the surface and MVFR criteria means a ceiling between 1,000 and 3,000 feet and/or 3 to 5 miles visibility inclusive.

<sup>22</sup> Low Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. LIFR criteria means a ceiling below 500 feet agl and/or less than 1 miles visibility.

FXUS61 KOKX 091456

AFDOKX

AREA FORECAST DISCUSSION

NATIONAL WEATHER SERVICE NEW YORK NY

1056 AM EDT FRI AUG 9 2013

.SYNOPSIS...

**A COLD FRONT AND PRE-FRONTAL TROUGH WILL APPROACH FROM THE WEST TODAY AND PASS THROUGH THE AREA THIS EVENING. HIGH PRESSURE BUILDS IN OVER THE WEEKEND AND INTO MONDAY. ANOTHER COLD FRONT WILL THEN MOVE THROUGH TUESDAY INTO TUESDAY NIGHT...FOLLOWED BY THE RETURN OF HIGH PRESSURE FOR WEDNESDAY AND THURSDAY.**

&&

.NEAR TERM /UNTIL 6 PM THIS EVENING/...

FORECAST GENERALLY ON TRACK. MINOR ADJUSTMENTS TO TEMPS AND TD GRIDS. BUMPED POPS UP ACROSS NORTHERN AND WESTERN SECTIONS FOR THE REST OF THE DAY...CONSIDERING TRENDS AND GUIDANCE FROM HI-RES MODELS. **ADDITIONALLY...SOME CONCERN ABOUT STORM POTENTIAL LATE THIS MORNING INTO THE AFTERNOON HOURS ACROSS THE APPROXIMATE EASTERN TWO THIRDS OF THE AREA. WITH THE APPROACH OF THE PRE-FRONTAL TROUGH...STRENGTHENING 850 JET AND THETA-E...AS WELL AS VERY HIGH MOISTURE ACROSS THE REGION...BETTER STORM ORGANIZATION IS POSSIBLE WITH A FEW OF THE STORMS. BIGGEST THREAT WOULD BE STRONG WIND GUSTS. MOST HI-RES GUIDANCE AGREES WITH BETTER DEVELOPMENT AROUND 16-20Z.**

DUE TO 1 TO 3 INCHES OF RAINFALL HAVING ALREADY OCCURRED ACROSS PORTIONS OF THE LOWER HUDSON...NORTHEAST NEW JERSEY...AND NORTHERN FAIRFIELD COUNTIES...WILL CONTINUE WITH A FLASH FLOOD WATCH THROUGH THIS EVENING FOR THESE AREAS. CONSIDERING THE HIGH PWATS BEING WORKED ON BY PASSING SHORTWAVES AND AN APPROACHING FRONT...MORE HEAVY RAINFALL IS EXPECTED...WHICH COULD RESULT IN LOCALIZED FLASH FLOODING WHERE HEAVY RAINFALL HAS ALREADY FALLEN.

THERE IS A HIGH RISK FOR RIP CURRENTS AT THE ATLANTIC BEACHES TODAY.

&&

.SHORT TERM /6 PM THIS EVENING THROUGH 6 PM SATURDAY/...

COLD FRONT WILL MOVE THROUGH BETWEEN 00Z AND 12Z SATURDAY...SO EXPECT SHOWERS AND THUNDERSTORMS TO WEAKEN AND END FROM WEST TO EAST LATE FRIDAY NIGHT INTO SATURDAY MORNING. HIGH PRESSURE BUILDS IN FOR SATURDAY AND USHERS IN A DRIER AIRMASS. DESPITE THE PASSAGE OF A COLD FRONT...MOSTLY CLEAR SKIES AND DOWNSLOPING...OFFSHORE WINDS WILL ALLOW FOR WARMER TEMPERATURES...WITH HIGHS RANGING FROM THE LOWER 80S INLAND TO UPPER 80S IN THE NYC METRO REGION.

&&

.LONG TERM /SATURDAY NIGHT THROUGH THURSDAY/...

QUIET WEATHER SHOULD PREVAIL FOR MOST OF THE LONG TERM PERIOD AS HIGH PRESSURE WILL DOMINATE THE WEATHER PATTERN FOR MUCH OF THE TIME. IT LOOKS LIKE THE ONLY CHANCES OF SHOWERS AND THUNDERSTORMS WILL BE MONDAY NIGHT THROUGH TUESDAY EVENING AS A COLD FRONT APPROACHES AND PASSES THROUGH.

TEMPERATURES ARE EXPECTED TO BE CLOSE TO NORMAL THROUGH TUESDAY...THEN A LITTLE COOLER THAN NORMAL WEDNESDAY AND THURSDAY. TUESDAY COULD BE ON THE MUGGY SIDE...OTHERWISE COMFORTABLE HUMIDITY LEVELS ARE EXPECTED.

&&

**.AVIATION /15Z FRIDAY THROUGH TUESDAY/...**

CONVECTION OUT AHEAD OF A COLD FRONT OVER WESTERN SECTIONS OF PA AND NY WILL IMPACT THE TERMINALS THROUGH MUCH OF THE DAY. GENERALLY LOOKING AT A MVFR-LIFR CONDITIONS ACROSS THE AREA TERMINALS THROUGH THIS AFTERNOON. RAINFALL ACROSS THE NORTHERN TERMINALS WILL LIFT TO THE NORTH LATE THIS MORNING. FOR THIS AFTERNOON WILL SEE ANOTHER ROUND OF CONVECTION ALONG AND AHEAD OF THE PRE-FRONTAL TROF. THE MAIN IMPACT LOOKS TO BE BRIEF HEAVY RAINFALL AND WINDS GUSTS UP TO 40 MPH. A FEW GUSTS UP TO 20 KT EXPECTED BY AFTERNOON. COLD FRONT CLEARS AREA THIS EVENING WITH CONDITIONS IMPROVING TO VFR. SOME PATCHY MVFR FOG MAY LINGER FOR A WHILE THIS EVENING BEFORE DRIER AIR WORKS IN ON A W/NW FLOW AT LESS THAN 10 KT.

NY METRO ENHANCED AVIATION WEATHER SUPPORT...  
 DETAILED INFORMATION...INCLUDING HOURLY TAF WIND COMPONENT FCSTS CAN BE FOUND AT: [HTTP://WWW.ERH.NOAA.GOV/ZNYY/N90](http://www.erh.noaa.gov/znny/n90) (LOWER CASE)  
 KEWR FCSTER COMMENTS: AMENDMENTS LIKELY DUE TO UNCERTAINTY IN TIMING AND AREAL EXTENT OF CONVECTION TODAY.  
 THE AFTERNOON KEWR HAZE POTENTIAL FORECAST IS YELLOW...WHICH IMPLIES SLANT RANGE VISIBILITY 4-6SM OR GREATER OUTSIDE OF CLOUD.  
 KJFK FCSTER COMMENTS: AMENDMENTS LIKELY DUE TO UNCERTAINTY IN TIMING AND AREAL EXTENT OF CONVECTION TODAY. IFR-LIFR CIGS MAY PERSIST FOR SEVERAL HOURS LONGER THAT FORECAST.  
 KLGA FCSTER COMMENTS: AMENDMENTS LIKELY DUE TO UNCERTAINTY IN TIMING AND AREAL EXTENT OF CONVECTION TODAY.  
 KTEB FCSTER COMMENTS: AMENDMENTS LIKELY DUE TO UNCERTAINTY IN TIMING AND AREAL EXTENT OF CONVECTION TODAY.  
 KHPN FCSTER COMMENTS: AMENDMENTS LIKELY DUE TO UNCERTAINTY IN TIMING AND AREAL EXTENT OF CONVECTION TODAY.  
 KISP FCSTER COMMENTS: AMENDMENTS LIKELY DUE TO UNCERTAINTY IN TIMING AND AREAL EXTENT OF CONVECTION TODAY. POSSIBLE IFR CIGS LASTING INTO THE AFT.

.OUTLOOK FOR 12Z SATURDAY THROUGH TUESDAY...  
 .SAT...VFR.  
 .SUN-MON...MAINLY VFR.  
 .MON NIGHT-TUES...POSSIBLE SHRA/TSRA WITH MVFR CONDITIONS.  
 &&  
 .MARINE...  
 WINDS PICK UP FROM THE S TO SW...ALLOWING WAVES TO BUILD TO 5 TO 7 FT ON THE COASTAL OCEAN WATERS LATER THIS MORNING. THERE MAY BE OCCASIONAL WIND GUSTS TO 25 KT ACROSS THE EASTERN COASTAL OCEAN WATERS BY THE END OF THE DAY. SCA CONDITIONS CONTINUE INTO TONIGHT FOR THE COASTAL OCEAN ZONES. WAVES WILL SLOWLY COME DOWN THROUGH SATURDAY MORNING. AS SUCH...SCA FOR HAZARDOUS SEAS REMAINS IN EFFECT FOR THE OCEAN WATERS.  
 CONDITIONS WILL REMAIN BELOW SCA LEVELS FOR THE REST OF THE FORECAST PERIOD AS WINDS REMAINS NEAR OR BELOW 10 KT.  
 &&  
 .HYDROLOGY...  
 AN ADDITIONAL HALF INCH TO AN INCH AND A HALF OF RAINFALL WILL BE POSSIBLE FROM THIS MORNING THROUGH TONIGHT WITH LOCALLY HIGHER AMOUNTS. THE HIGHER AMOUNTS WILL GENERALLY BE NORTH AND WEST OF THE CITY. THERE IS A DECENT CHANCE OF ADDITIONAL MINOR URBAN/POOR DRAINAGE AND SMALL STREAM FLOODING...AS WELL AS SOME LOCALIZED FLASH FLOODING.  
 NO SIGNIFICANT PCPN IS EXPECTED SAT-THU.  
 &&

.EQUIPMENT...  
THE NOAA ALL HAZARDS WEATHER RADIO TRANSMITTER IN NEW YORK CITY  
IS OFF THE AIR...AND UNAVAILABLE UNTIL FURTHER NOTICE. TECHNICIANS  
ARE CURRENTLY INVESTIGATING THE PROBLEM.  
&&  
.OKX WATCHES/WARNINGS/ADVISORIES...  
CT...FLASH FLOOD WATCH UNTIL 10 PM EDT THIS EVENING FOR CTZ005.  
NY...FLASH FLOOD WATCH UNTIL 10 PM EDT THIS EVENING FOR NYZ067>070.  
NJ...FLASH FLOOD WATCH UNTIL 10 PM EDT THIS EVENING FOR NJZ002-004-  
103-104.  
MARINE...SMALL CRAFT ADVISORY FOR HAZARDOUS SEAS UNTIL 6 AM EDT  
SATURDAY FOR ANZ350-353-355.  
&&  
\$\$

### 13.0 National Weather Service Hazardous Weather Outlook

The National Weather Service Office in New York, New York, issued the following Hazardous Weather Outlook at 0845 EDT which discussed the moderate to locally heavy rainfall possible with the showers and thunderstorms moving across the area into the evening hours:

FLUS41 KOKX 091245  
HWOOKX  
HAZARDOUS WEATHER OUTLOOK  
NATIONAL WEATHER SERVICE NEW YORK NY  
845 AM EDT FRI AUG 9 2013  
CTZ006>012-NJZ006-105>108-NYZ071>074-078-079-176-177-101245-  
NORTHERN NEW HAVEN-NORTHERN MIDDLESEX-NORTHERN NEW LONDON-  
SOUTHERN FAIRFIELD-SOUTHERN NEW HAVEN-SOUTHERN MIDDLESEX-  
SOUTHERN NEW LONDON-HUDSON-WESTERN ESSEX-EASTERN ESSEX-WESTERN UNION-  
EASTERN UNION-SOUTHERN WESTCHESTER-NEW YORK (MANHATTAN)-BRONX-  
RICHMOND (STATEN ISLAND)-NORTHWESTERN SUFFOLK-NORTHEASTERN SUFFOLK-  
NORTHERN QUEENS-NORTHERN NASSAU-  
845 AM EDT FRI AUG 9 2013  
THIS HAZARDOUS WEATHER OUTLOOK IS FOR SOUTHERN  
CONNECTICUT...NORTHEAST NEW JERSEY AND SOUTHEAST NEW YORK.  
**.DAY ONE...TODAY AND TONIGHT.**  
**MODERATE TO LOCALLY HEAVY RAINFALL WILL BE POSSIBLE TODAY INTO THE**  
**FIRST PART OF TONIGHT AS A COLD FRONT MOVES THROUGH THE REGION.**  
**LOCALIZED FLASH FLOODING IS A POSSIBILITY WITH ANY THUNDERSTORMS**  
**THAT DEVELOP.**  
.DAYS TWO THROUGH SEVEN...SATURDAY THROUGH THURSDAY.  
THE PROBABILITY FOR WIDESPREAD HAZARDOUS WEATHER IS LOW.  
.SPOTTER INFORMATION STATEMENT...  
WEATHER SPOTTERS ARE ENCOURAGED TO REPORT SIGNIFICANT WEATHER  
CONDITIONS ACCORDING TO STANDARD OPERATING PROCEDURES.  
&&  
THIS HAZARDOUS WEATHER OUTLOOK PROVIDES A SUMMARY OF POTENTIAL  
WIDESPREAD HAZARDOUS WEATHER EVENTS THAT MAY REACH NWS WARNING  
CRITERIA. MOST LONG FUSED NWS WATCHES...WARNINGS AND ADVISORIES IN  
EFFECT ARE HIGHLIGHTED.  
PLEASE REFER TO THE LATEST NWS FORECASTS FOR WEATHER NOT MEETING NWS  
WARNING CRITERIA.  
\$\$

CTZ005-NJZ002-004-103-104-NYZ067>070-101245-  
 NORTHERN FAIRFIELD-WESTERN PASSAIC-EASTERN PASSAIC-WESTERN BERGEN-  
 EASTERN BERGEN-ORANGE-PUTNAM-ROCKLAND-NORTHERN WESTCHESTER-  
 845 AM EDT FRI AUG 9 2013  
 ...FLASH FLOOD WATCH IN EFFECT THROUGH THIS EVENING...  
 THIS HAZARDOUS WEATHER OUTLOOK IS FOR SOUTHERN  
 CONNECTICUT...NORTHEAST NEW JERSEY AND SOUTHEAST NEW YORK.  
 .DAY ONE...TODAY AND TONIGHT.  
 PLEASE LISTEN TO NOAA WEATHER RADIO OR GO TO WEATHER.GOV ON THE  
 INTERNET FOR MORE INFORMATION ABOUT THE FOLLOWING HAZARDS.  
 FLASH FLOOD WATCH.  
 MODERATE TO LOCALLY HEAVY RAINFALL WILL BE POSSIBLE TODAY INTO THE  
 FIRST PART OF TONIGHT AS A COLD FRONT MOVES THROUGH THE REGION.  
 LOCALIZED FLASH FLOODING IS A POSSIBILITY WITH ANY THUNDERSTORMS  
 THAT DEVELOP.  
 .DAYS TWO THROUGH SEVEN...SATURDAY THROUGH THURSDAY.  
 THE PROBABILITY FOR WIDESPREAD HAZARDOUS WEATHER IS LOW.  
 .SPOTTER INFORMATION STATEMENT...  
 WEATHER SPOTTERS ARE ENCOURAGED TO REPORT SIGNIFICANT WEATHER  
 CONDITIONS ACCORDING TO STANDARD OPERATING PROCEDURES.  
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 THIS HAZARDOUS WEATHER OUTLOOK PROVIDES A SUMMARY OF POTENTIAL  
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 EFFECT ARE HIGHLIGHTED.  
 PLEASE REFER TO THE LATEST NWS FORECASTS FOR WEATHER NOT MEETING NWS  
 WARNING CRITERIA.  
 \$\$  
 NYZ075-080-081-178-179-101245-  
 KINGS (BROOKLYN)-SOUTHWESTERN SUFFOLK-SOUTHEASTERN SUFFOLK-  
 SOUTHERN QUEENS-SOUTHERN NASSAU-  
 845 AM EDT FRI AUG 9 2013  
 ...HIGH RIP CURRENT RISK IN EFFECT THROUGH THIS EVENING...  
 THIS HAZARDOUS WEATHER OUTLOOK IS FOR SOUTHEAST NEW YORK.  
 .DAY ONE...TODAY AND TONIGHT.  
 PLEASE LISTEN TO NOAA WEATHER RADIO OR GO TO WEATHER.GOV ON THE  
 INTERNET FOR MORE INFORMATION ABOUT THE FOLLOWING HAZARDS.  
 HIGH RIP CURRENT RISK.  
 MODERATE TO LOCALLY HEAVY RAINFALL WILL BE POSSIBLE TODAY INTO THE  
 FIRST PART OF TONIGHT AS A COLD FRONT MOVES THROUGH THE REGION.  
 LOCALIZED FLASH FLOODING IS A POSSIBILITY WITH ANY THUNDERSTORMS  
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 WIDESPREAD HAZARDOUS WEATHER EVENTS THAT MAY REACH NWS WARNING  
 CRITERIA. MOST LONG FUSED NWS WATCHES...WARNINGS AND ADVISORIES IN  
 EFFECT ARE HIGHLIGHTED.  
 PLEASE REFER TO THE LATEST NWS FORECASTS FOR WEATHER NOT MEETING NWS  
 WARNING CRITERIA.  
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#### **14.0 Pilot Weather Briefing**

The weather briefing information from Lockheed Martin Flight Service (LMFS) is provided as attachment 1 and 2. The verbal and text briefings contained all the standard information including METARs, TAFs, wind aloft information, SIGMETs valid for the route of flight, and AIRMETs. During the verbal abbreviated briefing, the briefer mentioned the AIRMETs for IFR and moderate turbulence conditions, and also includes the convective SIGMET valid along the route of flight. For more information please see attachment 1 and 2.

#### **15.0 Astronomical Data**

The astronomical data obtained from the United States Naval Observatory for the accident site on August 9, 2013, indicated the following:

<b>SUN</b>	
Begin civil twilight	0525 EDT
Sunrise	0555 EDT
Sun transit	1257 EDT
Sunset	1958 EDT
End civil twilight	2029 EDT

#### **F. LIST OF ATTACHMENTS**

Attachment 1 – Verbal Weather Briefing from LMFS

Attachment 2 – Text Weather Briefing Information from LMFS

Paul Suffern  
NTSB, AS-30